MODEL 599H VLF RECEIVER

OPERATION AND SERVICE MANUAL

February 1967

599806-0001X1

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If any fault develops, notify TRACOR, Inc. and give full details, including model and serial numbers. You will then be notified as to the disposition of the defective instrument.

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599806-0002X1

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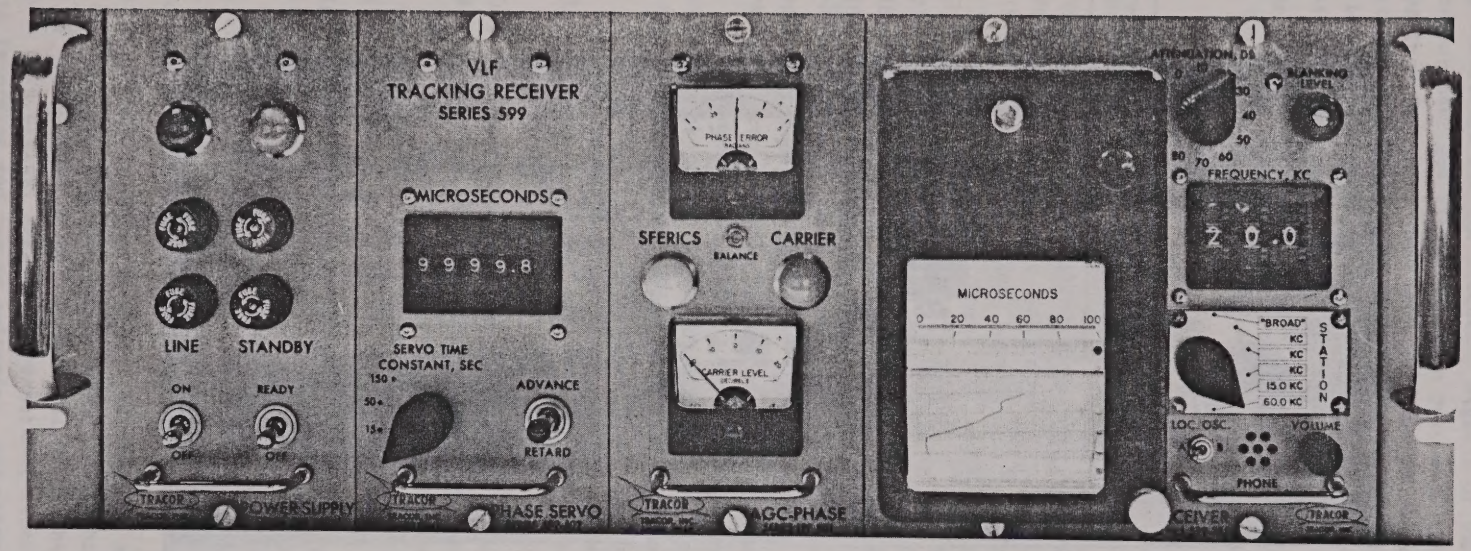
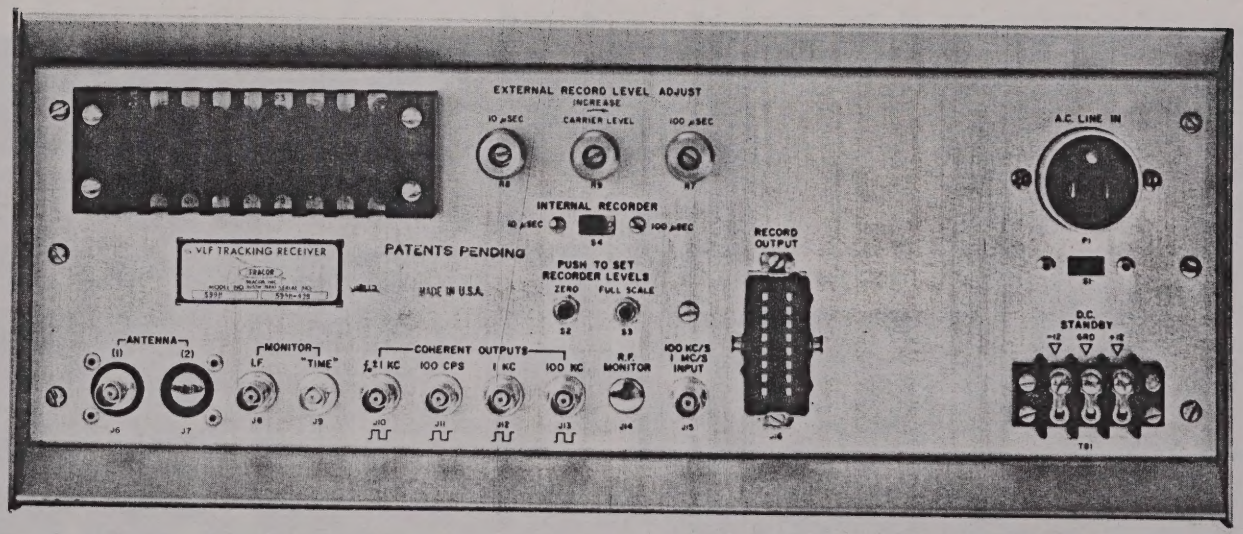


MODEL 599H VLF RECEIVER

FRONT VIEW



MODEL 599H VLF RECEIVER

REAR VIEW

I. INTRODUCTION

The all solid-state TRACOR Series 599 VLF Tracking Receiver has been expressly developed to utilize the highly stabilized carrier frequency signals of VLF stations for time and frequency calibration, measurement and standardization purposes. Phase-locked reception of these VLF signals gives long-term and short-term accuracy that is generally several orders of magnitude better than that obtainable by reception of WWV or WWVH. Frequency measurement to an accuracy of 1 part in 10^9 can be achieved in intervals as short as 30 minutes; observation over 24-hour intervals gives a measurement accuracy of several parts in 10^{11}.

VLF stations which transmit on the basis of controlled carrier frequencies are listed in Table I.* The Series 599 receiver provides reliable tracking on any of these stations at

TABLE I

Station	Frequency (kc/s)	Location	Sponsor
WWVL	20.0	Ft. Collins, Colorado	Natl. Bureau of Standards
NBA	24.0	Balboa, Canal Zone	U. S. Navy
NPM	19.8	Lualualei, Hawaii	U. S. Navy
NAA	17.8	Cutler, Maine	U. S. Navy
NPG	18.6	Jim Creek, Washington	U. S. Navy
NSS	21.4	Annapolis, Maryland	U. S. Navy
GBR	16.0	Rugby, England	British Post Office
OMEGA	10.2 & 13.6	Various; global net	U. S. Navy

receiving locations nearly anywhere in the world. (For reception of the OMEGA transmission, an auxiliary switch programmer is required for selection of a particular OMEGA station from the network of stations.) A thumbwheel digital switch, reading station frequency directly in kilocycles/second, provides quick tuning to any desired VLF station. A total of 240 discrete channels, in 100 cps steps, is available between the lower limit of tracking operation at 8.0 kc/s and the upper limit of 31.9 kc/s. (In addition to this broad VLF coverage, optional models of the receiver incorporate a converter which permits tracking of the 60.0 kc/s transmissions of WWVB, the LF frequency standard station operated by the National Bureau of Standards.)

The Series 599 unit is a fully integrated phase-locked receiving system for frequency standardization purposes. The system incorporates various major functional elements into a single instrumentation package -- VLF receiver, phase comparator, servo phase shifter, frequency synthesizer and power supply. Only an external frequency standard and an antenna must be connected to the unit.

A front panel digital counter displays continuously the relative time difference between the phase of the incoming VLF carrier frequency and the phase derived from the local frequency source. Phase changes as small as 0.1 microsecond are clearly discernible. Outputs to an external chart recorder are also provided so that a permanent record of the accumulated phase difference can be made. The Model 599F and 599H versions incorporate a built-in strip chart recorder so that an external recorder is not required.

The versatile Series 599 VLF Tracking Receiver incorporates many advanced features for increased sensitivity, reliability, and superior performance capability under diverse field conditions in a variety of application areas. Modifications of the servo response characteristics, means for improved antenna directivity, Doppler compensation, extended frequency coverage, provision for auxiliary data recording and remote switching, and other instrumentation features can be incorporated to meet specific requirements; the TRACOR engineering staff will be glad to provide additional information and technical assistance.

*All frequency standard transmissions are based on the UT2 time scale, the universal time scale in civil use throughout the world. The U. S. Navy frequency assignments are subject to change without notice. Frequencies listed here are those in use as of August, 1964.

II. SYSTEM DESCRIPTION

A simplified block diagram of a basic VLF phase tracking receiver system is shown in Figure 2-1. The phase comparator compares the phases of the incoming VLF carrier and the locally synthesized reference signal. The output of the comparator is used to control an electronic phase shifter so as to maintain a phase null. The phase Φ_A of the shifted reference signal is thus automatically locked to the phase Φ_{VLF} of the VLF carrier.

The major elements of the Series 599 VLF Phase-tracking Receiver are shown in Figure 2-2. The incoming VLF carrier signal, after preliminary amplification and RF filtering, either with a broadband all-channel filter or a narrower filter for selective reception, is converted to a 1 kc/s intermediate frequency. (The basic phase and amplitude information is retained in this simple frequency conversion process.) The IF signal, after further amplification and filtering, is then coherently phase detected in two synchronous detectors. The output of one synchronous detector is the phase error signal to the phase servo; the output of the other detector, driven in quadrature, produces a coherent voltage for AGC purposes.

The AGC circuit maintains a constant output signal and uniform gain in the phase tracking servo loop, even though the amplitude of the received VLF signal may change drastically due to propagation or modulation factors. Furthermore, if the VLF carrier signal drops below a minimal value, the carrier level relay is shortly thereafter de-energized. This disconnects the servo system and ensures that the phase shifter will not drift in the absence of a true signal. Servo tracking resumes automatically when the VLF carrier reappears.

Since the electronic phase shifter operates at 10 Mc/s, one cycle of phase shift always corresponds to 0.1 μsec of time shift, independent of the particular VLF station being tracked. Each full cycle of phase change is recorded on the front panel bi-directional counter, which provides a cumulative record of phase shift. The counter is calibrated in tenths of microseconds and has a cumulative capacity of 9999.9 μsec.

The phase-shifted 10 Mc/s signal is divided to provide both 100 kc/s and 10 kc/s signals, which are compared to the external standard by two linear phase comparators.

The 100 kc/s phase comparator has a full scale range of 10 μsec and the 10 kc/s phase comparator has a full scale range of 100 μsec. Both outputs are available for recording on an external recorder. (In the Model 599H, the output of either phase comparator can be recorded on the internal recorder by means of a rear panel switch)

The phase-shifted 100 kc/s signal is used in the synthesizer module in the derivation of the locally generated reference frequency. Also, the phase shifted 100 kc/s signal is frequency divided to give coherent 1 kc/s and 100 cps signals for use internally and as coherent outputs for external use. The coherent 100 cps frequency is used to synchronize the desired local oscillator signal at the reference frequency $f_o \pm 1$ kc/s. This reference frequency is readily adjustable from 9.0 to 30.9 kc/s in increments of precisely 100 cps. The synthesized reference frequency, phase-locked to the coherent 100 cps signal, is highly phase stable.

The ability of a phase-locked VLF receiver to track weak VLF signals in the presence of strong incoherent noise depends upon the frequency selectivity and special noise discrimination features used. Filtering in the frequency domain, accompanied by blanking in the time domain, is used in the Series 599 receiver to reduce the effect of sferics and other impulse types of noise. The blanking circuit effectively disconnects the receiver from the antenna during noise bursts. Front panel sferics lamp flashes indicate presence of sferics and facilitate adjustment of blanking level to suppress impulse noise. Since the main source of noise in the VLF region is sferics, which are particularly susceptible to this noise suppression technique, a marked improvement in signal-to-noise ratio can often be achieved by this method.

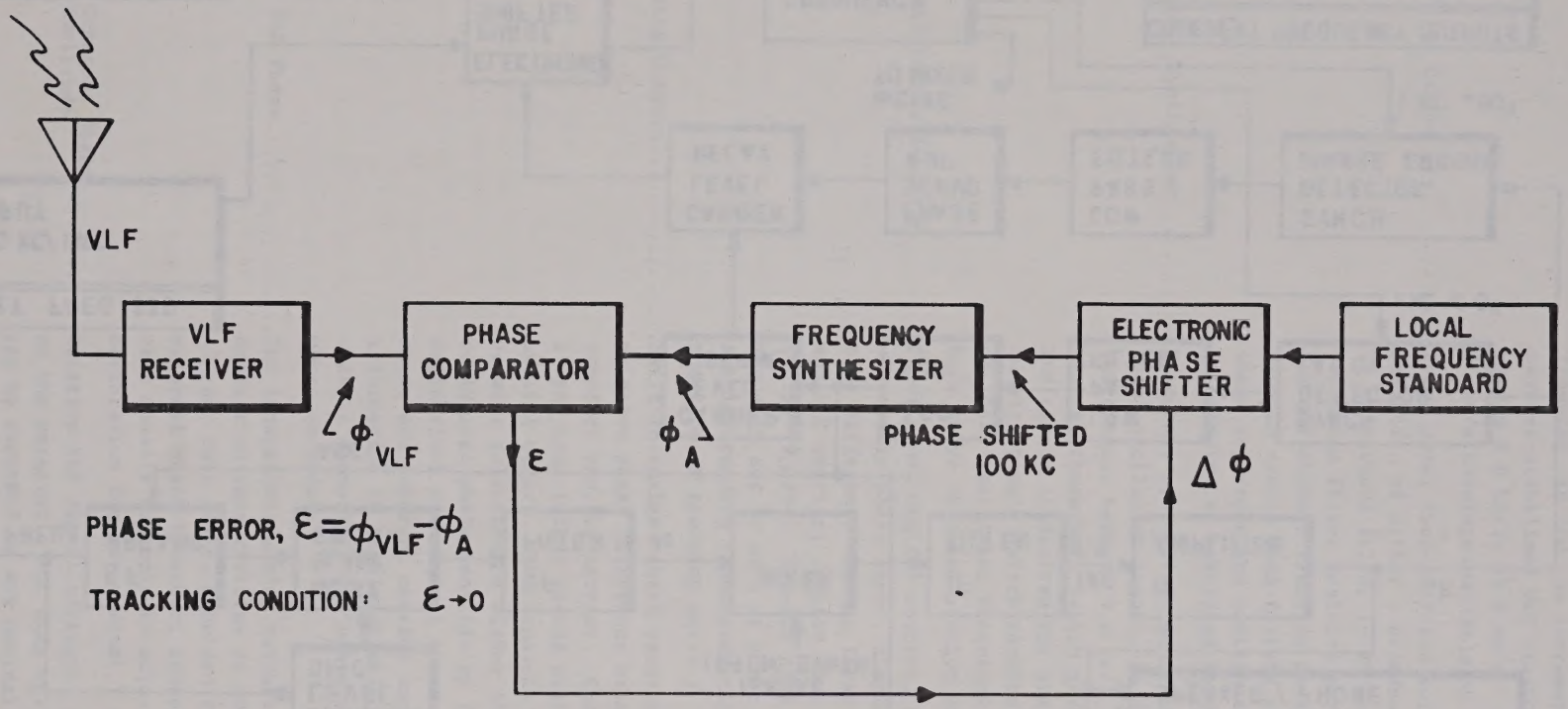


Fig. 2-1 — SIMPLIFIED DIAGRAM OF VLF PHASE TRACKING RECEIVER SYSTEM

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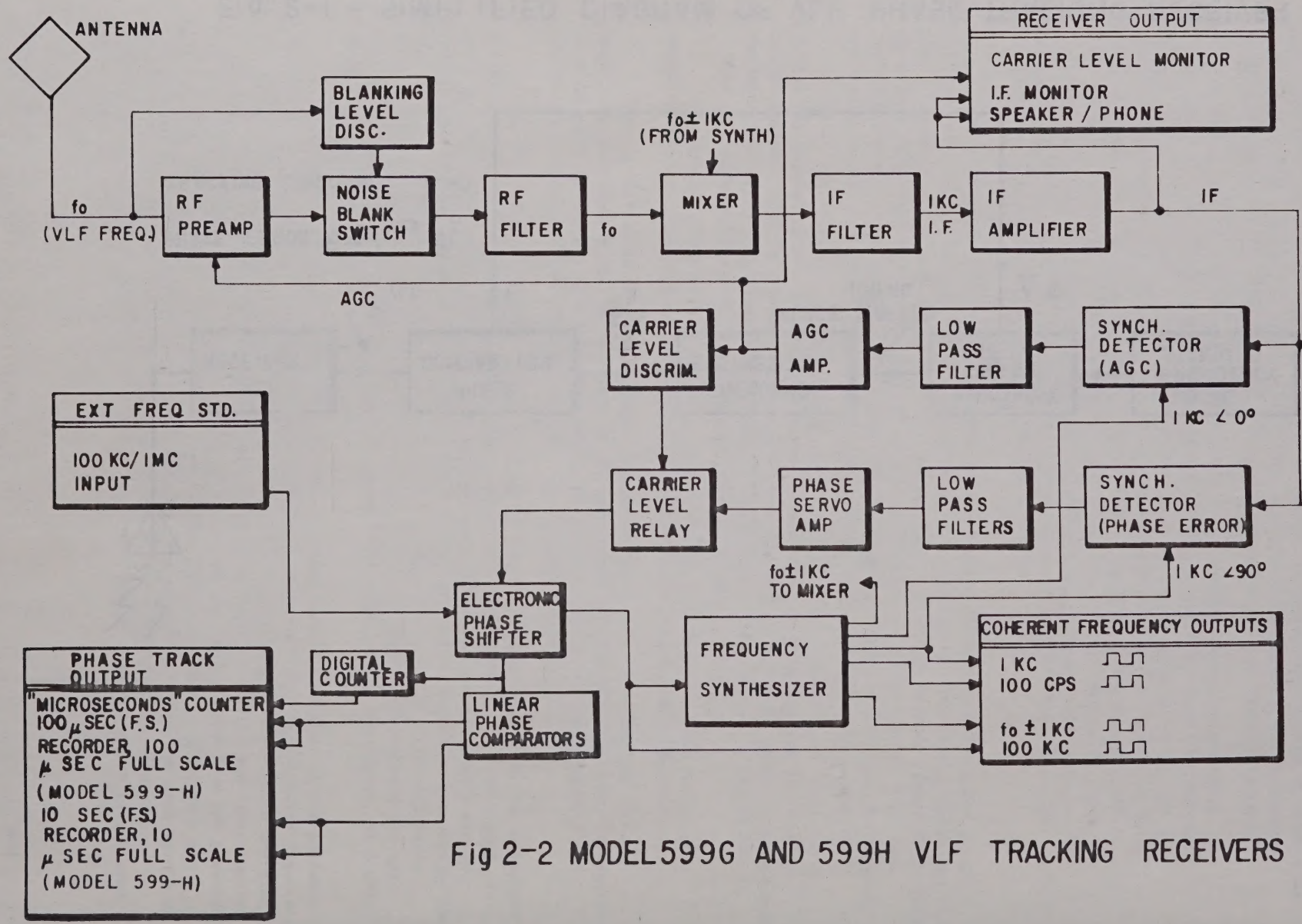

Fig 2-2 MODEL599G AND 599H VLF TRACKING RECEIVERS

III. SPECIFICATIONS

A. General

Frequency Coverage.....Standard receiver provides 240 channel tracking, in 100 cps increments, for all carrier-stabilized VLF stations in the region 8.0 kc/s- 31.9 kc/s. (Additional 60 kc/s coverage available on special order.)

RF Filter Capability.....Front panel five-position switch permits selection of either a broadband filter or narrowband filter in RF section. Broadband filter position normally used for all-channel tracking capability; plug-in narrow band filters provide image rejection and additional frequency selectivity at specified frequencies.

Frequency Synthesizer.....Frequency synthesizer generates coherent local oscillator signal, in 100 cps increments, between 9.0 kc/s and 30.9 kc/s. Digital thumbwheel switch gives direct indication of desired VLF station frequency; toggle switch permits selection of local oscillator frequency either 1 kc/s above or below station frequency.

Time Difference Register.....Front panel digital counter, pulsed by electronic phase servo, displays relative time difference between local standard and VLF carrier; counter dial cumulative to 9999.9 μsec. Counter dial may be manually set to zero or other desired initial reading (independently of phase position of tracking servo.)

Recording Outputs.....Built-in inkless chart recorder records relative phase difference between local standard and VLF carrier. Chart speed: 1" per hour (other speeds available on special order). Rear chassis switch permits selection of either 100 μsec or 10 μsec phase sensitivity (full scale deflection) of internal chart recorder. Phase and coherent carrier amplitude information is also available, on rear chassis connector, for use with external chart recorder:

1. VLF Phase.....Two independent analog outputs, having deflection sensitivities of 100 μsec and 10 μsec full scale, provided for use with external chart recorder; independent rear chassis controls to adjust span calibration for any nominal 1 ma recorder.

2. Coherent Signal Amplitude.....Relative VLF signal strength, equivalent to the receiver's AGC bias voltage, can be recorded on any nominal 1 ma recorder or potentiometric recorder; nominal logarithmic characteristic over a 40 db range (chart records linear on a db scale).

Meter Display.....Individual front panel meters indicate:
a) relative carrier level: 40 db full scale range
b) phase detector error voltage (on zero-center meter).

Auxiliary Outputs.....Following outputs are available on rear chassis BNC connectors
a) Amplified VLF station signal, at 1 kc/s intermediate frequency and phase coherent with RF carrier.
b) Phase shifted 100 kc/s square wave, 0.5 Vpp nominal.
c) Phase shifted 1 kc/s square wave, 0.5 Vpp nominal.
d) Phase shifted 100 cps square wave, 0.5 Vpp nominal.
e) Reference frequency (L.O.), offset 1 kc/s from VLF carrier, nominal 0.5 Vpp square wave.

Audio Output.....Built-in speaker and volume control for aural monitoring of VLF station at approximately 1 kc/s.

Frequency Standard Input.....Requires stable 1 Mc/s or100 kc/s signal from external frequency standard; single BNC connector input on rear chassis; recommended input level 0.5-5.0 volt rms into 1000 ohms.

Antenna Requirements.....Designed for use with loop, whip, or simple wire antenna; shielded loop antenna (Model 599-600 or equal) recommended for high noise locations. Antenna may be located any distance from receiver. 100 ft of 50 ohm coaxial cable (RG-58U with BNC connectors) supplied with receiver.

Bandwidth.....a) RF Bandwidth (narrow band filters)--nominal 500 cps
b) If Bandwidth--50 cps, nominal
c) Servo Bandwidth (equivalent noise bandwidth): selectable from 0.002 cps to 0.06 cps (see following table under Phase Tracking Servo).

Noise Suppression.....Blanking circuit rejects impulse noise, either man-made or atmospheric ('sferics'); front panel lamp indicated presence of blanked noise impulse and facilitates adjustment of blanking circuit control.

Servo Disable Circuit.....Electronic switch diables phase servo whenever VLF carrier drops below minimal level; front panel warning lamp lights at same time. Tracking resumes automatically when carrier returns.

Ambient Temperature Limits.....0°C to + 50°C, while operating (+65°C maximum storage temperature).

B. Performance

Receiver Sensitivity.....0.01 microvolt signal (corresponding to 0.3 microvolt/meter field strength at 20.0 kc/s with Model 599-600 Loop Antenna)into receiver energizes carrier level switch and enables normal phase tracking; tracking maintained at an input signal-to-noise ratio of -50 db (Gaussian noise measured in a 1 kc/s bandwidth; servo time constant switch in 50 sec position).

Phase Tracking Servo.....Front panel selector switch provides following servo response characteristics:

Nominal Time Constant (sec)	Equivalent Noise Bandwidth (cps)	Max. Tracking Rate (nominal)
5	0.06	$\pm$ 1 x 10^{-6}
15	0.02	$\pm$ 3.3 x 10^{-7}
50	0.006	$\pm$ 1 x 10^{-7}
150	0.002	$\pm$ 3.3 x 10^{-8}

Nominal servo deadband: less then $\pm$ 0.1 usec in all switch positions. Manual servo slewing: momentary contact, center-off toggle switch provided to advance or retard phase servo at a nominal 1 usec/sec rate.

Calibration Accuracy.....Short-term and long-term stability better than $\pm$ 0.5 usec under normal laboratory conditions; intrinsic calibration accuracy (relative to received VLF carrier) nominally better than $\pm$ 1 x 10^{-11} on a 24-hour basis.

Synthesizer Stability.....Phase of the coherent local oscialltor signal is absolutely fixed by the synthesizer setting; the synthesizer, after being switched to other frequencies, shows less than $\pm$ 0.05 usec shift when returned to its original setting.

AGC.....Stable AGC circuit assures full-reliability phase locked servo operation over a 40 db range of carrier level with total variation of phase shift less than 0.5 usec (equivalent, at 20 kc).

Dynamic Range.....Total signal level operating range in excess of 120 db (including 80 db manual gain control and 40 db AGC range).

C. Mechanical and Power

Power Requirements.....95-125 volt ac, 48-62 cps 40 watts nominal, or dc source (e.g., +12 volt and -12 volt dc standby batteries.)

External standby batteries, when used, automatically assume full operating load in the event of primary ac power failure. All receiver functions, including servo tracking, are sustained without interruption; however, chart drive motor in motor in recorder stops during ac power off time. Standby current drain approximately 600 ma at +12 VDC and 600 ma at -12 VDC.

Dimensions.....19" rack panel, 7" high, 16-1/2" overall depth behind panel.

Weight.....45 pounds.

Packaging.....Circuits are packaged in the following modules:
Unit 202 -- Receiver/Synthesizer/Recorder
Unit 302 -- AGC/Phase Error
Unit 402 -- Phase Servo
Unit 502 -- Power Supply

IV. INSTALLATION AND ALIGNMENT

A. Installation

1. The equipment should be carefully unpacked and examined. The modules are color coded and keyed for mounting; Plate I shows the modules properly installed. Care should be exercised in removing and installing the modules to ensure that the connector contacts are not damaged.

2. The antenna should be connected to the rear chassis coaxial input connector, J6, labeled ANTENNA (1). The antenna itself should preferably be mounted on top of a roof or in some clear area away from any major sources of interference; however, for temporary installations, an indoor location may be acceptable.

3. Connect a precision, stable source of 100 kc/s or 1 Mc/s to the rear chassis connector, J15, marked 100 kc/1 mc INPUT. The amplitude of the external frequency standard source should be between 0.5 and 5 volts rms. The frequency should be stable to a part in 10^7.

4. If it is desired to use an auxiliary battery supply to guard against line power failures, two 12 volt automotive batteries should be connected to "-12" and GND and to "+12" and GND on the rear chassis terminal strip, TB1. NOTE: The STANDBY switch must be OFF when this connection is made.

B. Alignment

Alignment of the tracking receiver for use with a desired VLF station involves a few simple steps:

Selection of appropriate STATION RF Filter in receiver,
Tuning of station FREQUENCY in Synthesizer,
Adjustment of receiver ATTENUATION control,
Adjustment of BLANKING LEVEL control to suppress impulse noise,
Selection of SERVO TIME CONSTANT.

A detailed procedure for initial alignment of the system is given below.

1. Adjust the controls as follows: (with antenna and frequency standard connected)

   a. LINE switch to OFF.
   b. STANDBY switch to OFF.
   c. Receiver ATTENUATION control approximately 30 db.
   d. STATION selector switch to desired station.
   e. BLANKING LEVEL control to full counterclockwise.
   f. VOLUME to approximately mid-range.
   g. SERVO TIME CONSTANT to 50 sec.

2. Plug ac power cord into a 115 v, 60 cps outlet.

3. Turn LINE switch ON. Allow TEN minutes for circuits and capacitors to reach equilibrium.

4. Tuning the Local Oscillator. Set digital thumbwheel switch to VLF station FREQUENCY KC. Ten seconds should be allowed for the circuit to stabilize after changing frequencies. The local oscillator frequency may be set above or below the received signal. If the LOC. OSC switch is set on position "A," the frequency synthesized will be 1 kc/s above what is indicated on the selector switch; if on "B," it will be 1 kc/s below. It is possible to tune off of a station and return to resume where tracking was left off, but only if the LOC. OSC. switch is in the same position it occupied before. Chapter VI, pages 6-7 and 6-8, of this manual explains more fully the "A" and "B" positions. (REMINDER: A = above; B = below).

5. Phase Alignment (adjustment of MICROSECONDS counter and phase servo). With the synthesizer adjusted to give the proper local oscillator frequency and with the receiver attenuator at approximately 30 db, or less if the anticipated carrier level is quite low, the front panel meters should deflect and indicate that a coherent VLF signal is being received.

If a signal is being received but a large phase error is present, the PHASE ERROR panel meter will show a definite deflection to the right or left. The operator may assist phase-track acquisition by using the ADVANCE/RETARD switch to adjust the SERVO in the same direction that the signal would: the SERVO should be advanced for a right hand deflection (+) of the phase error meter and retarded for a left hand deflection (-).

If a large phase error exists, the SERVO should be advanced or retarded 2-5 microseconds, followed by a wait of 5-10 seconds before continuing adjustments. If the operator overshoots the desired phase null condition, the meter will fully reverse deflection. Smaller adjustments can be used as the null region is approached.*

Adjustment of the servo time constant depends upon application and upon tracking conditions. Using the longer time constants will produce a "smoother" phase record. Shorter time constants allow tracking with larger fractional frequency offsets. For further information on problems encountered in particular locations and applications, contact the Manufacturer or Manufacturer's representatives.

6. Receiver Attenuation Control Adjustment. The final adjustment of receiver ATTENUATION should be made only after the phase error meter shows a small deflection. The ATTENUATION control should then be set so that the meter shows roughly "0 db". On a keyed signal of varying duty cycle, the gain should be set, by trial and error if necessary, to ensure that adequate AGC will be developed at all times to prevent opening of the carrier relay. Furthermore, if it is known that the signal level will follow a predictable diurnal pattern, this behavior should be taken into account and the gain adjusted so that the anticipated changes produce neither abnormally low nor abnormally high meter readings.

During adjustment of the phase shifter it is possible for the CARRIER LEVEL meter to drop below -20 db and the CARRIER alarm light to come on. This situation can occur whenever there is a 90° phase error in the AGC synchronous detector (corresponding to a similar error in phase tracking); however, the ALARM light will go out soon after this abnormal phase error is removed.

Most VLF stations have periods of silence. At the beginning of one of these intervals, the CARRIER LEVEL will slowly drop off. If the station remains silent for some time, the ALARM will ultimately light and phase tracking will stop. (The same effect will be observed if the antenna cable is disconnected.)

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* No null will exist for a station using frequency modulation or phase shift keying in which the carrier is not uniquely defined. For such transmissions, the phase error meter may first swing violently in one direction and then swing equally violently in the opposite direction. When this occurs, it is quite likely that no servo tracking action will occur in spite, in some cases, of a loud keying, audible in the receiver loudspeaker or earphone.

7. Adjustment of BLANKING LEVEL Control. The major source of noise in the VLF band, apart from local man-made signals, is the radiation generated by lightning flashes. These bursts are known as sferics. The peculiar amplitude distribution of sferics signals makes the noise suppression technique known as blanking a very effective method for their suppression. A blanking circuit is included in the receiver. This circuit opens the signal path for a time after a sferic signal exceeds a threshold. This technique prevents the random impulses of the sferics from entering the narrow band portion of the receiver and causing false error signals.

The BLANKING LEVEL control is located on the front of the receiver module. For strong VLF signals, this control may be left in the full CCW Position. For weak signals suffering interference from sferics, the control should be set at different trial positions, and the best position determined experimentally. Under some conditions an improvement of 20 db in signal to noise ratio may be gained by blanking, at the sacrifice of only one db of signal power.

To adjust the blanking control, observe the following procedure: while watching the SFERICS lamp, slowly advance the screwdriver BLANKING LEVEL control clockwise. After a quarter turn or so, depending on noise conditions, an occasional sferics lamp flash will occur. For each flash the receiver blanking switch opens. Continue rotating the control until the clockwise stop is reached, or until the sferics lamp shows a nearly continuous dim glow. If the latter occurs, rotate the control counterclockwise until the irregular flashing mode once again occurs.

It should be pointed out that the blanking technique is beneficial only when there is strong impulse noise. On "quiet" days it does little good. During a severe thunderstorm activity, however, a marked improvement in signal/noise ratio, observable both on the phase error meter and by aural monitoring of the VLF signal, can be achieved by proper use of the blanking circuit.

If the receiver is located in a very high field strength region close to some VLF transmitter, the blanking level discriminator may be energized by the VLF carrier itself. Under such circumstances, the BLANKING LEVEL control should be reduced so that the SFERICS lamp does not flash whenever the station is keyed on. If some VLF carrier signal, rather than random impulse noise, operates the blanking circuit, there is the possibility that large phase errors can be developed; in other words, the sferics blanking circuit is intended only for sferics and other types of random impulse noise signals.

8. An external recorder can be used (in parallel with the built-in recorder of Model 599H) for monitoring the phase change of the local frequency standard relative to the received VLF carrier. The external recorder, if a galvanometric type, should require not more than 1 ma current and should have an internal resistance of not more than 2000 ohms. The external recorder should be connected to the rear panel RECORD OUTPUT connector as shown in Figure 4-1.

The rear chassis RECORD ADJUST rheostat, R7, is used to adjust the span of the external recorder so that full scale deflection corresponds to a 100 μsec phase change. Actuate the ZERO switch on the back panel and adjust the recorder for zero reading. Then actuate the FULL SCALE switch on the back panel and adjust the recorder for full scale reading. The external chart recorder is now calibrated to indicate 100 μsec relative phase shift.

Adjustment of the 10 μsec record output is the same as for the 100 μsec record output, except that R8 is used to adjust the recorder for full scale.

Adjustment of the built-in recorder, which is essentially the same as for the external recorder, is discussed in detail in Chapter VII.

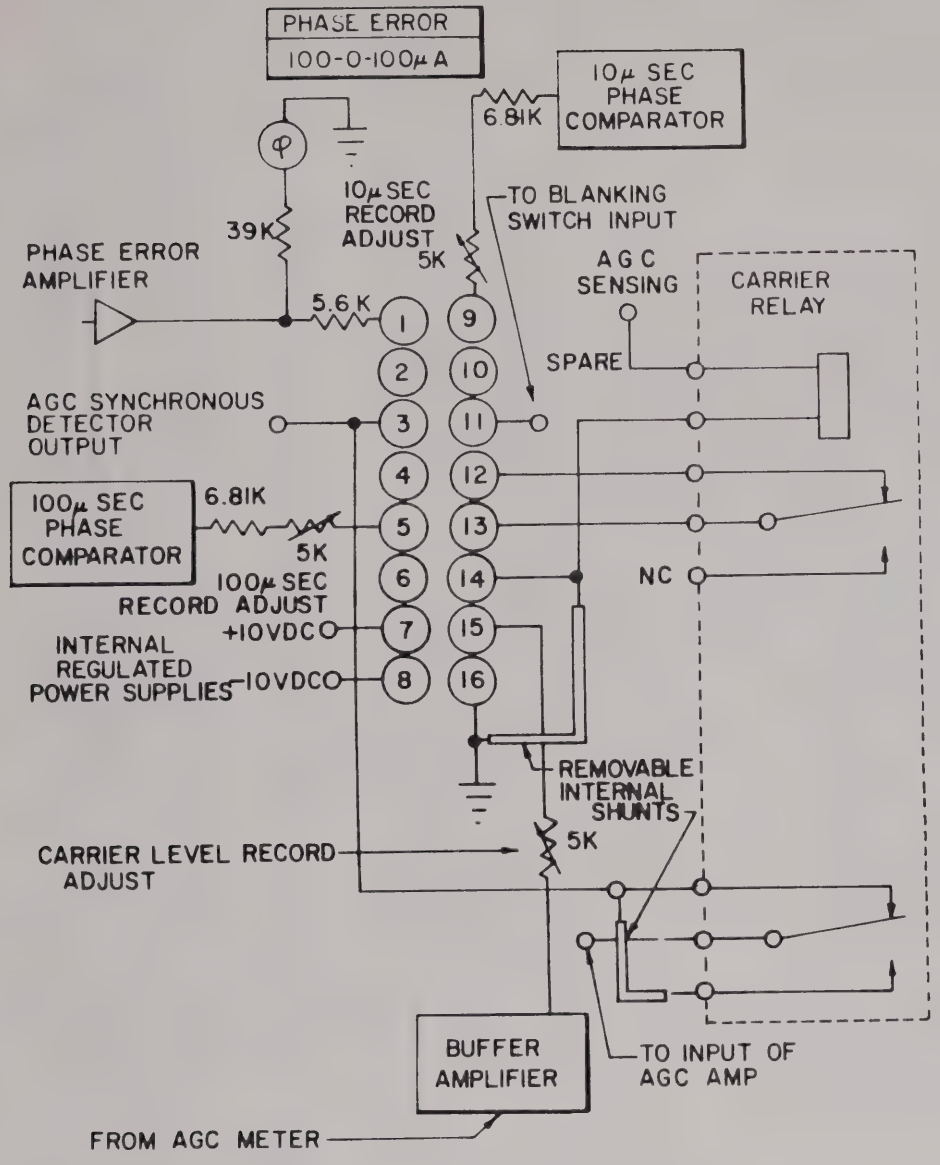
9. When the STATION selector switch is placed in the ALL position, the broadband filter is selected and the receiver can be tuned to frequencies between 8.0 kc/s to 31.9 kc/s. When the STATION selector switch is placed in any of the other positions, narrow band filters are selected, thereby reducing the possibility of interference. Interference may be a problem where two station frequencies are separated by 2 kc/s. Under this condition it will be necessary that either (a) the LOC. OSC. be switched so that the local oscillator frequency does not lie midway between the two station frequencies, or (b) the proper narrowband filter be used.

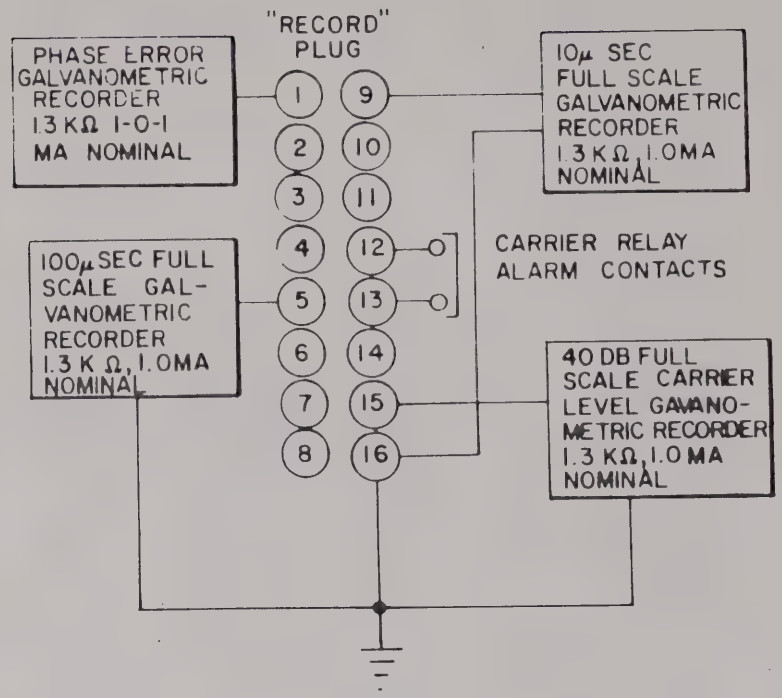
10. Proper tracking can be checked at any time by advancing or retarding the SERVO roughly 2-5 microseconds from its equilibrium tracking position and seeing whether the phase servo moves back to this position. It is desirable to check for proper tracking by <u>both</u> advancing and retarding.

Also, daily or weekly, the antenna cable should be disconnected at the receiver. The PHASE ERROR meter should then show negligible deflection from its zero-center position. If the PHASE ERROR meter shows more than 0.1 radian steady deflection with antenna disconnected, the BALANCE control, directly beneath the meter, should be slowly adjusted to null the meter.

11. It should be remembered that extremely long time constant circuits are used in the receiver, particularly in the AGC control loop. Thus, in initial adjustment the CARRIER LEVEL meter may remain below its threshold and the red CARRIER light remain on for some time after the phase shifter has been adjusted in accordance with the procedure outlined in Step 5 above (for very weak VLF signals and large ATTENUATION values this time may extend to several minutes).

12. Audio identification of the VLF station being tracked, even in the presence of a loudly interfering station in the PHONE output (Model 599G) or speaker (Model 599H), can be aided by momentarily throwing the LOC. OSC. toggle switch to its other position. The VLF station being tracked will obviously remain at the same intermediate frequency (at exactly 1 kc/s) and its audio tone will therefore remain unchanged. The interfering signal, however, will shift in frequency. (NOTE: The phase-tracking servo has an extremely narrow bandwidth and is consequently able to track a selected VLF station in the presence of interfering signals that appear quite loud to the ear.)





TYPICAL RECORDER SETUPS

NOTES:
1. "RECORD ADJUST" POTS CAN BE VARIED TO GIVE 0.8 TO 1.3 MA INTO LOADS BETWEEN 1.0 AND 2.0 KOHMS. (EXTERNAL SHUNT OR SERIES RESISTANCE CAN BE USED WITH MORE SENSITIVE RECORDERS WHERE DESIRED.)
2. RECEIVER WILL NOT FUNCTON NORMALLY WITH ANY OF THE FOLLOWING PINS ON THE "RECORD OUTPUT" CONNECTOR SHORTED TO GROUND: 3,5,7,8,9 OR 11.

Fig. 4-1 "RECORD OUTPUT" CONNECTION DIAGRAM

V. APPLICATION

VLF tracking receivers have applications in the following technical areas:

A. Frequency measurement, calibration and standardization (of precision crystal oscillators, atomic frequency standards, and other highly stable frequency sources).

B. Timing and synchronized clock systems

C. Investigation of VLF propagation phenomena

D. Navigation

Each of these application areas will be discussed briefly.

A. Frequency Measurement, Calibration, and Standardization

Use of the receiver for frequency calibration of any frequency standard with an available 100 kc/s or 1 Mc/s output is simple and straightforward. Any relative frequency error between the local frequency standard and the received VLF carrier signal will be observable as a phase drift on the MICROSECONDS digital counter. The rate of this phase drift can be directly interpreted as a fractional frequency error in the local standard; thus, a phase rate of 1 μsec in a 100 second time interval represents a fractional frequency deviation of 1 part in 10^8.

Table 1 presents several useful conversion factors. The fractional frequency error for observed phase changes over various elapsed time intervals can also be obtained from the graphs given in Figure 5-1.

TABLE 1

1 min = 60 sec = 6×10^7 μsec

1 hr = 3600 sec = 3.6×10^9 μsec

1 day = 8.64×10^4 sec = 8.64×10^{10} μsec

1 microsecond/min = 1.667×10^{-8}

1 microsecond/hr = 2.78×10^{-10}

1 microsecond/day = 1.16×10^{-11}

Fractional frequency error, $\frac{\Delta f}{f} = \frac{\text{difference in microseconds}}{\text{elapsed time in seconds}} \times 10^{-6}$

Suppose that the front panel MICROSECONDS counter reads 5240.1 at 9:00 A.M. and later at 1:30 P.M. of the same day, reads 5278.4. The elapsed time is thus 4 hours 30 minutes or 16,200 seconds. Similarly, the net phase difference is 5278.4 - 5240.1 = +38.3 microseconds.

$$\frac{\Delta f}{f} = \frac{+38.3}{1.62 \times 10^4} \times 10^{-6} = +2.36 \times 10^{-9} .$$

(The "+" sign in the frequency deviation, corresponding to an increase in the MICROSECONDS counter reading with time, implies that the local frequency standard is high in nominal frequency).

A similar calculation can be made using the microsecond difference information taken from the chart recorder (taking into account the fact that each full scale deflection of the chart trace represents an additional 100 microsecond phase change, either positive or negative as the case may be). The phase resolution of the receiver, as read on the MICROSECONDS counter, is typically ±0.1 microseconds; accordingly, frequency comparisons to an accuracy of parts in 10^9 (relative to the received VLF carrier) can be obtained within an interval of 10-30 minutes.

The VLF region is characterized by extremely stable propagation, particularly during all-daylight path conditions. Rather large phase changes can occur during the sunrise and sunset transition intervals and, to a lesser extent, during night-time. The diurnal shift from daytime to night-time reception is in the order of 15-50 microseconds for most locations at moderate ranges from the VLF stations. The phase propagational pattern is quite repeatable and predictable on a day-to-day basis; measurements made during all-daylight propagation path conditions typically indicate an intrinsic accuracy of ± 1 microsecond, or better.

Accordingly, for highest possible accuracy observations should be made at 24 hour intervals, in the vicinity of local noon or during an all-daylight path for the selected VLF station. It is highly desirable that a continual log be maintained, either by recording the readings on the MICROSECONDS digital dial or the chart records on a daily basis.

In reading the chart records of the accumulated phase error it should be recognized that the recorder displays an incremental range of 100 μsec. The total net change in phase over an elapsed time interval can be obtained, however, by keeping track of the full excursions of the recorder (each full excursion representing a net phase change of either +100 μsec or -100 μsec). The procedure to be followed can be understood by reference to Figure 5-2. Here we show a "typical" phase tracking record (the heavy solid trace) over an interval of several days. During the first day the local standard was high in frequency, as evidenced by the post-dawn chart scale reading of roughly 40 μsec and the late afternoon reading of 80 μsec. At 6 PM the recorder pen reached the upper limit of the chart record and immediately swung back to the opposite side of the recorder. The discontinuity in the record occurs at the "fly-back" point of the phase comparators. It is obvious that the real phase behavior of the local standard, if the recorder pen could have continued its motion beyond the edge of the chart paper, would have been that shown as a dotted trace in the upper portion of Figure 5-2 below. Thus, if we assume that the phase reading was approximately "50 μsec" at noon of the first day, the proper phase reading at noon on the second day is obviously "120 μsec" (rather than simply "20 μsec").

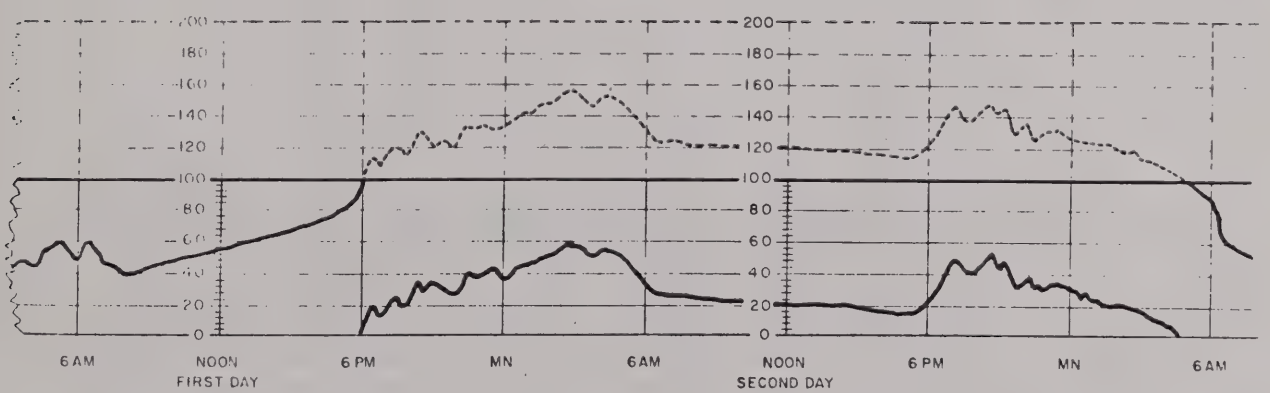


Fig. 5-2

Fig. 5-3 illustrates the type of frequency calibration record which can be achieved on a routine basis. The data shown here were obtained with a high quality 2.5 mc/s crystal oscillator shortly after it had been placed in operation. On 21 November the noon reading of the MICROSECONDS counter was 0317.2; on 22 November the reading was 0342.6 microseconds, indicating that the oscillator was high in average frequency by +25.4 microseconds over the corresponding 24-hour interval.

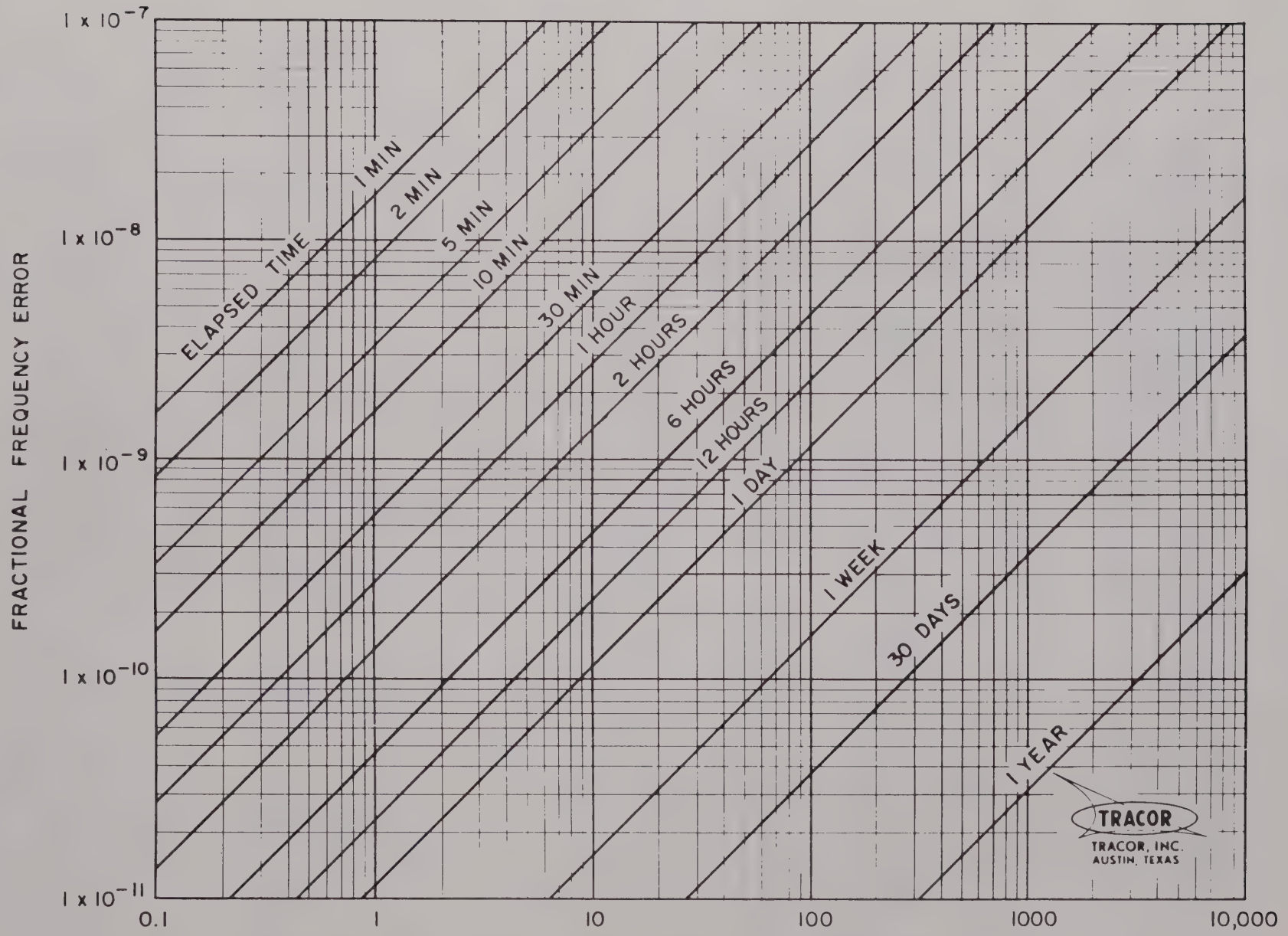


Figure 5-1. ACCUMULATED TIME ERROR, MICROSECONDS

Frequency drift characteristics of the oscillator can best be visualized by converting the basic data (as shown in Fig. 5-3) over to a daily "frequency error" plot as shown in Fig. 5-4.

Fig. 5-4 shows that the frequency standard was high in frequency, by approximately $+3 \times 10^{-10}$ at the start of the test (as derived from the observed +25.4 microsecond change during the first 24-hour period); furthermore, the plot shows that the oscillator shifted steadily toward lower frequency values. Thus, by 2 December the oscillator no longer showed a positive frequency error; at that time the MICROSECONDS counter was nearly stationary, indicating almost perfect synchronism with the received WWVL carrier frequency. During subsequent days the oscillator moved progressively lower in frequency; by 11 December, twenty days after the start of the recording, the oscillator had a fractional frequency error (relative to WWVL) of roughly -2.5×10^{-10}.

The fact that the VLF stations sometimes stop transmitting need not interfere with the frequency calibration capability. Thus, in the above record, WWVL had two scheduled maintenance periods -- on 26 November and 10 December -- when the station was off the air for 12 hours. During these long intervals the phase servo was automatically disabled; however, as soon as the station resumed its transmissions, the servo system quickly pulled into its proper equilibrium position. (There is always danger, however, that one or more cycles of the R.F. carrier will be gained or lost during an extended "off" time, particularly if the frequency standard has a sufficiently large frequency offset so that the accumulated phase error can approach 180° during that interval. Generally, however, the gain or loss of an R.F. cycle can be easily recognized if a graph of the MICROSECONDS reading is properly maintained.)

Frequency control of any high stability oscillator can best be maintained if its frequency performance is continually monitored and recorded in this graphical form. Frequency adjustments should be performed only when the drift records indicate that the oscillator is no longer within the desired tolerance. The maximum interval between adjustments depends upon the quality of the oscillator (particularly with respect to its "aging" characteristic or the rate at which its frequency changes with time) and some specified frequency tolerance. Thus, for the case of the crystal oscillator shown in Figs 5-3 and 5-4, it is evident that adjustments every 21 days should be adequate if we wish to maintain the oscillator to an accuracy of $\pm 3 \times 10^{-10}$ relative to WWVL; on the other hand, if an accuracy of $\pm 1 \times 10^{-10}$ is required at all times, it would then be necessary that adjustments be performed at least weekly. Most high quality oscillators incorporate a vernier frequency control -- usually with dial divisions calibrated in parts in 10^{10} or even 10^{11} -- so that precision frequency adjustments can be made simply and with confidence. In some applications it may be preferred that vernier adjustments be made on a scheduled daily basis, rather than weekly or at random intervals; in any case, the procedure is based upon the information contained within the day-by-day graphs of accumulated phase changes.

In most applications it will be desirable that the oscillator be slightly overcompensated, rather than set exactly on frequency, whenever an adjustment is made. Thus, if experience indicates that the oscillator tends to drift (age) toward a lower frequency, the oscillator should always be adjusted so that it starts off with a positive frequency error; this overcompensation technique will result in the maximum time interval before another adjustment will be required to maintain the oscillator within specified tolerances.

Selection of the VLF station to be used for frequency correlation purposes depends upon many factors. Those groups involved in global network operation will undoubtedly be instructed to monitor some transmitter that can be reliably tracked at all receiving sites. A "primary" station and one or more "secondary" monitoring stations will be advisable so that no receiving site is wholly dependent upon a single transmitter.

There are strong reasons for using the National Bureau of Standards station WWVL for frequency correlation purposes, at least within the United States and the Western

Hemisphere. First of all, its central location provides favorable all-daylight propagation during normal working hours for groups on both the East and West coasts of the United States. Furthermore, evidence indicates that WWVL possesses higher stability, on a long-term basis, than any other VLF transmitter so that WWVL offers an excellent reference source for determining oscillator stability. Most important of all, the WWVL transmissions are directly related to the U. S. Frequency Standard, the National standard of frequency and time unit for the United States. Frequency calibration records based on the signals from WWVL are thus "directly traceable to the National Bureau of Standards" -- a familiar quality assurance requirement in many Government contracts. (For those groups requiring extreme calibration accuracy, the National Bureau of Standards publishes a bulletin listing the measured frequency deviation of the WWVL transmissions, on a daily averaging basis, from the U. S. Frequency Standard itself.)

At extreme ranges from the VLF transmitters it may be possible to receive signals along both the short great-circle path and the long great-circle path (from the opposite direction). Attenuation of VLF signals is somewhat lower along an over water and an all-darkness propagation path; consequently, if the longer path is essentially over water, there may be transitional intervals during each day when interference will be encountered. The interference, if substantial, will result in erratic phase tracking. The real danger, of course, is that one or more R.F. cycles will be gained or lost whenever the direction of the dominant signal reverses. The solution to this problem is either to use some other VLF station which shows no interference effect or, even better, use a cardioid type of antenna pattern to provide directional discrimination against the unwanted azimuthal component (the TRACOR Model 611 Cardioid Unit, with means for phasing of the signals from a loop antenna and a whip antenna, provides more than 30 db discrimination in the front-to-back antenna lobe pattern).

B. Timing Applications

The VLF tracking receiver is highly useful in timing applications involving long-term frequency synchronization of "clocks" at separated locations. By monitoring a selected VLF transmitter it is possible for each receiving location to operate from the same frequency and time base. Thus, if two timing systems are initially synchronized, they can thereafter remain locked together regardless of the fact that the elapsed time may extend into days, weeks, or years. The instantaneous "time drift" between two synchronized clocks or timing systems need only be that introduced by uncertainties in propagation time at the respective receiving locations.

The VLF tracking receiver provides a simple means for ensuring that widely separated locations operate from the same frequency/time base. The VLF phase record gives a direct measure of the time drift of the local frequency standard relative to the selected VLF station. As a first step, the frequency standard should be adjusted in accordance with the procedure described in the previous section. Again, if experience has indicated that the oscillator tends to age in a particular direction, it may be preferable that the oscillator be slightly overcompensated, rather than set to a zero frequency offset, whenever the frequency adjustment is performed. For timing applications, a useful criterion for performing any oscillator adjustment may be the accumulated phase drift (in microseconds) of the MICROSECONDS counter from some initial value; for example, if it is desired that the timing system never deviate more than ± 500 microseconds from some initial value, the oscillator need be adjusted only when the MICROSECONDS counter (or the equivalent chart records for the accumulated phase deviation) shows a net change approaching ± 500 microseconds. A continuing plot of daily phase readings, from the MICROSECONDS counter or interpreted from the chart records, can be used in determining the actual time error which exists on any given day; this known error can be added (or subtracted) to the timing system output so as to give a corrected time.

We have discussed the procedure for adjusting the local frequency source so that it provides an accurate, known frequency/time base. This ensures that "clocks" at widely separated locations run at the same rate. There remains, however, the problem of "zero setting" the clocks; that is, we need some method for initial time synchronization or setting

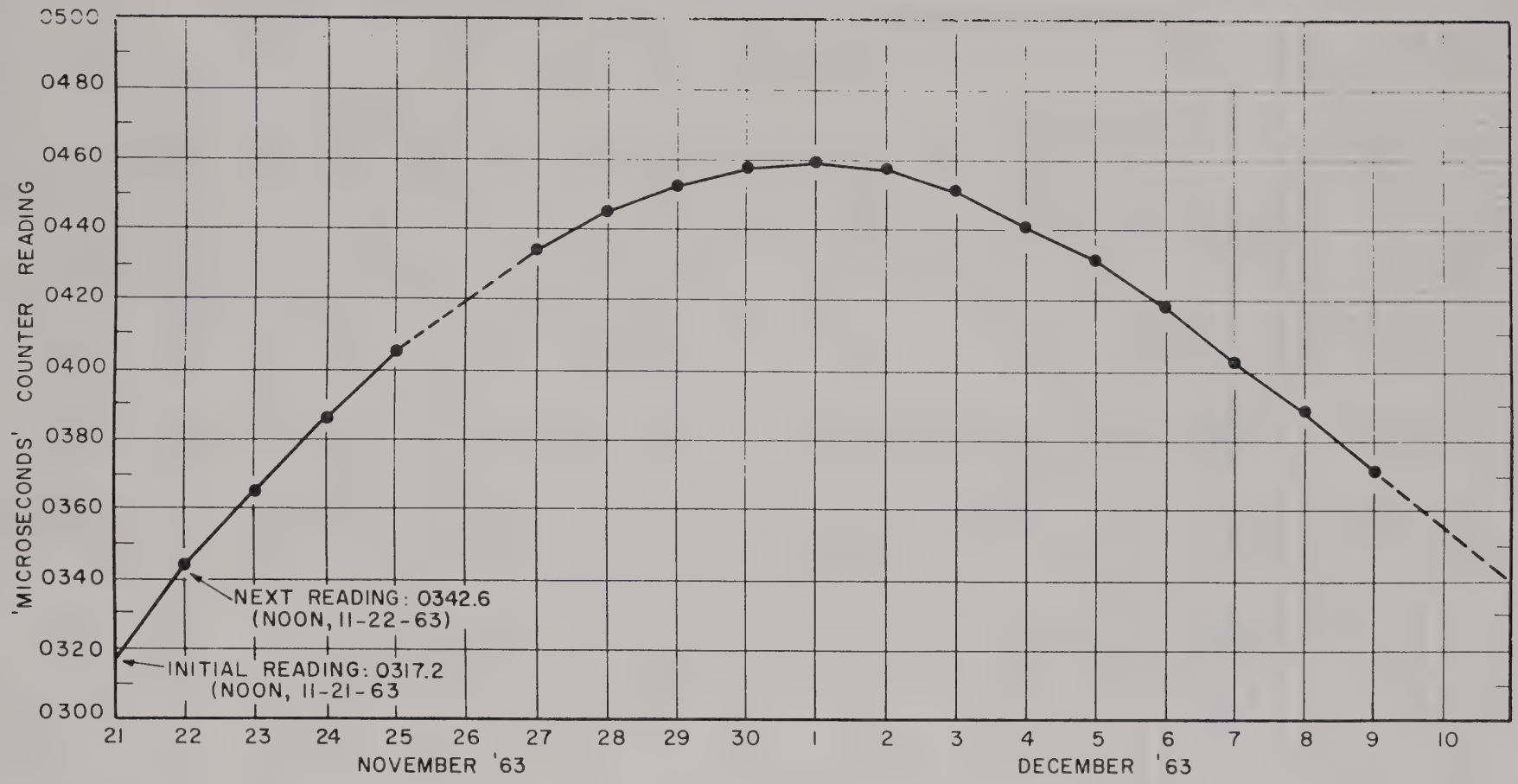


Fig. 5-3 PHASE TRACK READINGS:
SULZER 2.5 MC/S OSCILLATOR RELATIVE
TO WWVL AS RECEIVED IN AUSTIN, TEXAS

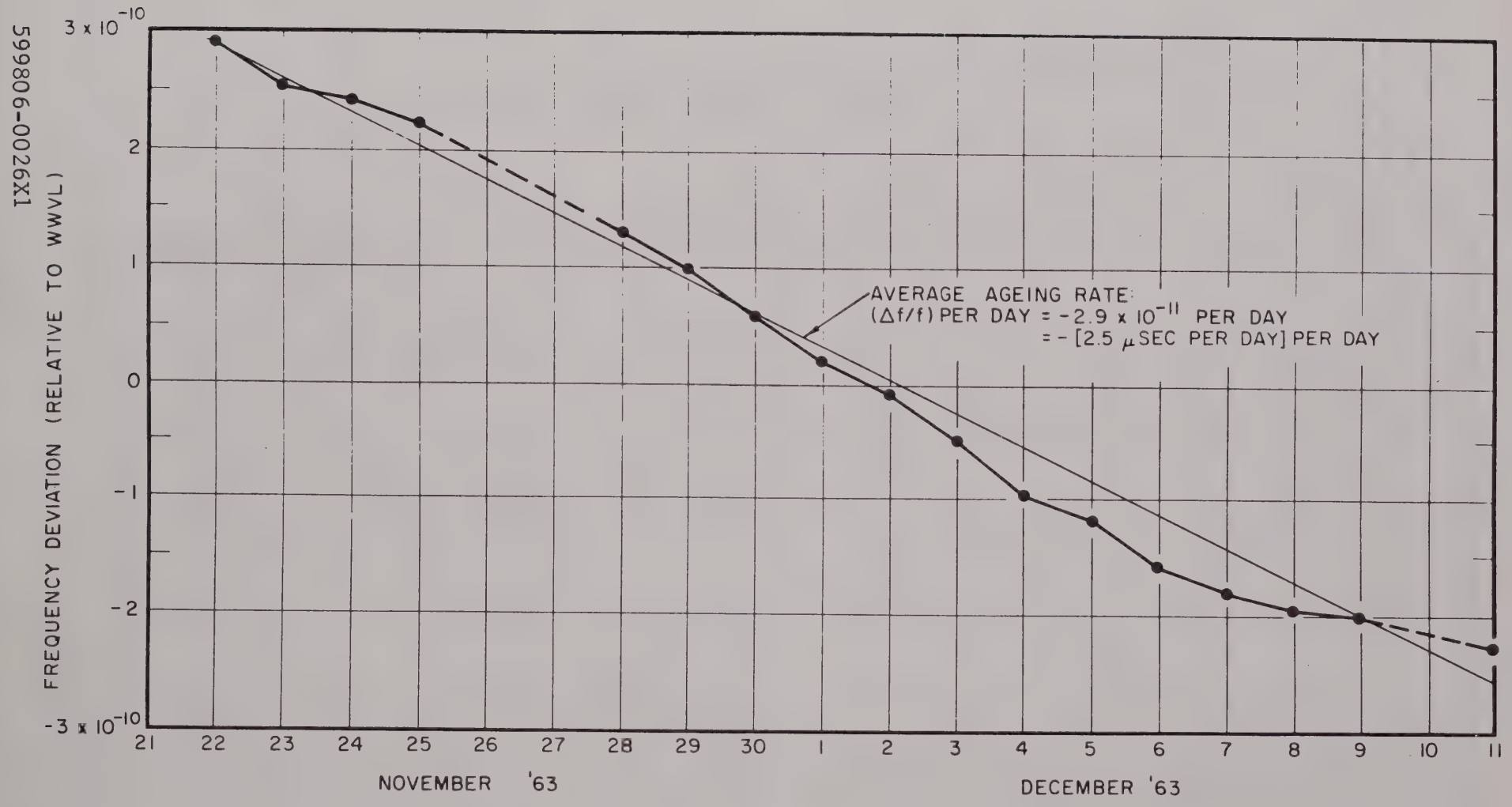


Fig. 5-4 FREQUENCY DRIFT (AGEING) CHARACTERISTIC OF SULZER OSCILLATOR (SEE Fig. 5-3)

in "time-of-day" information. Various schemes have been suggested for achieving time synchronization; none is fully satisfactory from an operational viewpoint under all conditions.

One synchronization method involves transporting a highly stable and accurate clock (controlled either by an atomic frequency standard or an ultrastable quartz crystal oscillator) from one location to another. If a basic frequency accuracy of 1 part in 10^{10} can be maintained in a transportable clock over a 24-hour interval, the accumulated time error will be held to less than 10 microseconds. For most locations within the United States, such "time" transfer could be completed within a few hours flight time, rather than 24 hours, so that "microsecond' time correlation throughout the United States appears clearly feasible. It must be emphasized that, once initial time synchronization has been achieved by means of a transportable clock, phase-locked reception of the VLF standard frequency signals can thereafter be used to maintain synchronization at the initial level of accuracy.

It is also possible to use the VLF transmissions directly for "time-of-day" information purposes. NBA, for example, transmits timing pulses at precise 1 sec intervals. Unfortunately, the modulation envelope of the keyed carrier rises very gradually so the exact start of the transmitted time pulse is difficult to recognize. The NBA transmitted signal has a rise time in the neighborhood of 1 milliseconds; a high antenna Q is required at the transmitter in order to achieve reasonable radiating efficiency at VLF frequencies.

The following procedure is suggested for those who wish to utilize the "timing pulses" from NBA or the other U. S. Navy VLF transmitters for time synchronization purposes. The I.F. MONITOR (J8) output at the rear of the receiver is connected to the vertical plates of an oscilloscope. The oscilloscope sweep should be triggered from a suitable 1 pps source. (The coherent 100 cps output, J11, from the receiver can be used with two decade dividers to give a stable 1 pps trigger.) The phasing of the 1 pps signal or of the sweep delay should be adjustable so that the start of the amplified VLF signal occurs near the start of the sweep trace.

A typical I.F. waveform of a received NBA pulse is shown in Fig 5-5. The "start" of the VLF signal can best be estimated by fitting a pair of straight lines to the initial portion of the modulation envelope; the intersection of these lines can be used to define "zero time." The effects of random noise can be reduced by averaging over many successive pulses, with a straight line fit being made for each recorded pulse envelope on a sequence of photographs.

Finally, it should be mentioned that the National Bureau of Standards has made preliminary investigation of an alternative modulation scheme which shows considerable promise. In this method the VLF station transmits on two closely spaced carrier frequencies (e.g., on 20.0 kc/s and 20.1 kc/s). This produces, in effect, a modulation envelope at the 100 cps difference frequency. Either one or two VLF tracking receivers can be used to provide accurate phase data on each of the two carriers; this, in turn, furnishes precise information on the modulation envelope itself. Preliminary two-frequency observations at TRACOR, obtained during experimental transmissions by WWVL in the 1963 summer, indicate significant improvements over the NBA "time tick" pulse modulation method; a stability of ± 50 microseconds in the equivalent modulation envelope was achieved with the low power (15 watt) WWVL transmissions.

C. Investigation of VLF propagation phenomena

Investigations of VLF propagation phenomena are being carried out by various agencies, here and abroad. These include studies of the diurnal change of altitude in the VLF-reflecting D layer of the atmosphere, studies of the effects of magnetic and sudden ionospheric disturbances, and comparisons of reception of the various VLF transmitters.

A sensitive VLF tracking receiver can be an invaluable tool in experimental investigations of ionospheric and propagational phenomena. With the versatile Model 599 receiver, both phase and amplitude characteristics of the incoming vector signal can be independently recorded; see Figure 4-1 for connector information.

The AGC bias voltage will be a function both of the received carrier amplitude and the duty cycle of the keying modulation. Thus, for calibrated recordings of carrier signal level it will be necessary that allowance be made for variations in modulation duty cycles or, alternatively, that measurements be made on stations such as WWVL or NBA which transmit on a known, uniform basis.

A precision attenuator (with 50 ohm input and output impedances) may be inserted into the antenna cable lead so as to obtain a calibration of recorder deflection vs relative signal level. To make an absolute calibration of the received input signal (in microvolts at the receiver input) it is necessary that a coherent type of generated test signal be available; a spare synthesizer module, if available, can be adjusted to give a local oscillator output equal to the R.F. frequency of the desired VLF test signal.

The Model 599 receiver has been used for measurements in the antipodal regions. Also, the equipment can be used for"vertical incidence" measurements of the ionospheric layer in the immediate vicinity of a VLF transmitter. For such measurements it is generally necessary that some form of special antenna system (e.g., cardioid pattern, a nulled loop, etc) be employed. (TRACOR will be glad to supply additional information to groups involved in special field measurements).

D. Navigation

VLF transmissions can be used for navigation purposes in areas where LORAN C or OMEGA transmissions are not received. A shipboard installation requires only readily available commercial components: a high quality quartz-crystal oscillator, two VLF tracking receivers, and a dual-channel chart recorder. A typical airborne installation would, in addition, include means for introducing compensation for the aircraft's velocity vector into the tracking servo. Preliminary test results indicate that "dead reckoning" navigational accuracy of 1 mile or less can be realized during all-daylight conditions. *

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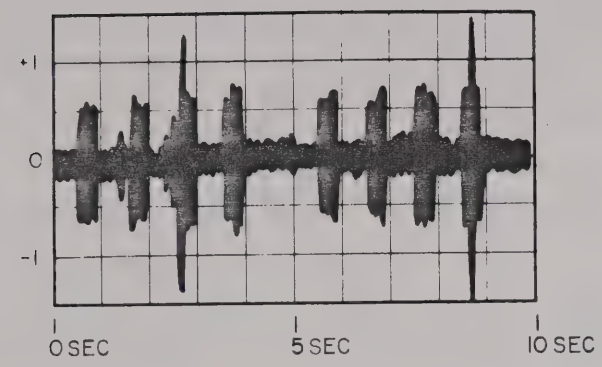
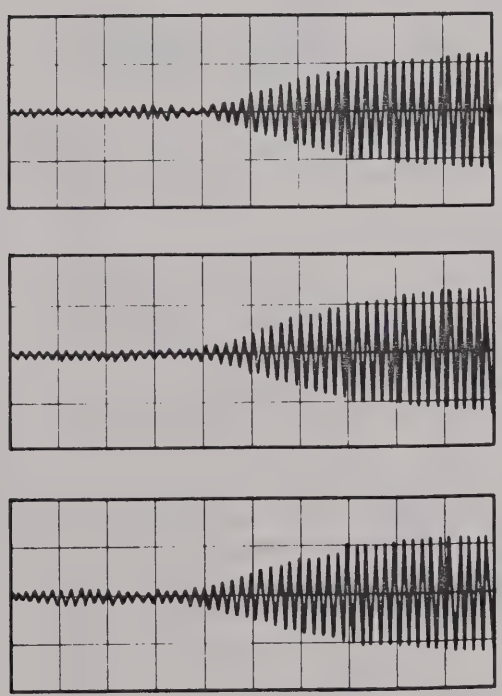
* Baltzer, O. J. "Navigation by means of VLF Radio Transmissions" Reprint of a technical paper presented at the 1963 National Winter Convention on Military Electronics, Los Angeles, California.

Stanbrough, J. H., Jr, and D. P. Keily. "Long-range Relative Navigation by Means of VLF Transmissions" Deep Sea Research, 1964, Volume II, 249-255.

Stanbrough, J. H., Jr. "A VLF Radio Relative Navigation System" Paper presented at the Annual National Meeting of the Institute of Navigation, 15-17 June 1964, New York, N. Y.



A. NBA 1 SEC. TIMING PULSES, WITH OMITTED PULSE FOR TIME-OF-DAY INFORMATION.



B. IF SIGNAL (1.0 KC/S) FOR NBA TRANSMISSION. SWEEP: 5 MSEC/DIV.

Fig. 5-5 —TYPICAL IF WAVEFORM OF NBA SIGNAL

VI. CIRCUIT DESCRIPTION

A. Receiver, Unit 599-202 (Assy 599624)

With the exception that the Digital Synthesizer supplies the f_o ±1 kc/s to the balanced mixer in the receiver, the Digital-Synthesizer and Receiver sections of the Receiver module perform independently of each other. The Digital Synthesizer and Receiver section circuits are, therefore, discussed separately.

1. Digital Synthesizer Section (see Figure 6-1)

a. Limiter/Frequency Divider (Assy 599592)

See Figure 6-2 and Drawing 599197 in Chapter IX.

The 100 kc/s Filter/Limiter is on Assy 599592 , and shown on Figure 6-2 and Drawing 599197 . Assy 599592 is a standard board for the 599 Series, so it includes the Filter/Limiter although the latter is not used when Unit 599-202 and Unit 599-402 modules are used together---that is, in the Model 599G and 599H.

The phase-shifted 100 kc/s signal from Unit 599-402 is coupled to the 100 kc/s pulse forming amplifier consisting of Q4 and Q5. The 100 kc/s input is thus transformed into a 100 kc/s square wave and transmitted by means of common-emitter amplifier Q6 to the pulse-type dividers.

The output of Q6 is fed not only to the frequency dividers but also to a voltage doubler consisting of CR1, CR2, C10 and C11. The dc output of this voltage doubler is fed to Assy 599590 where it serves to hold a circuit in the unlocked condition. If the 100 kc/s signal should fail, the voltage doubler output will drop to zero. This will cause circuitry within Assy 599590 to lock control loop I.

There are five pulse-type frequency dividers within the frequency divider circuitry of the Digital Synthesizer, and all of these dividers operate in an identical manner. Thus the following discussion of the operation of the first divider will also suffice for the remaining four.

The 100 kpps pulses from the 100 kpps pulse-forming amplifier enter the first divider through R15. Q7 and Q8, transistors having complementary polarities, are the active elements of this first divider stage. This divider accepts the 100 kpps pulse train and divides its frequency by five, delivering output pulses at a 20 kpps rate.

At the beginning of a cycle of operation of the divider, Q7 and Q8 are in a non-conducting state, and the potential at the emitter of Q8 is slightly greater than the -5 volts on the base of Q8. The -5 volts is supplied to Q8 from "N" through R17 ("N" is a nominal -5 volt regulated supply that is furnished by the regulator incorporating Q20, Q21 and Q22.) At this time an input pulse is transmitted through R15, raising the base potential of Q8 above that of the emitter and causing Q8 to conduct. Q8 collector current then flows through L2 and R19, biasing Q7 for conduction, and Q7 collector current begins to flow. This current reinforces the initial triggering current in the base of Q8. By virtue of this regenerative action, Q7 and Q8 quickly conduct very heavily, and after a very short time Q7 saturates, returning R17 and R18 directly to ground. For approximately a microsecond, Q7 and Q8 continue to conduct, the collector of one supplying current to the base of the other. (This pulse, transmitted through R18, serves as an input pulse to the next divider.)

Collector current for both Q7 and Q8 is obtained chiefly from the charge stored on C12; so when both transistors are conducting, C12 discharges rapidly, taking

the emitter of Q8 toward ground. By the time C12 has discharged to approximately -0.7 volts, the rate of change of charge on the condenser has dropped greatly, and the Q8 collector current is therefore considerably reduced and approaching a steady state. As the Q8 collector current approaches a steady state, the induced voltage across L2 falls to a value less than that required to keep Q7 conducting, and the transistor cuts off. When Q7 cuts off, the base of Q8 is returned to the -5 volt supply voltage, and Q8 therefore cuts off.

Then the "timing" part of the cycle begins. C12 is in a discharged state, so the Q8 emitter is very nearly at ground potential. Since Q7 is cut off, the Q8 base potential is -5 volts. After a brief interval C12 begins to charge through R20 and the emitter potential of Q8 approaches that of the base. Because of the high initial Q8 emitter potential, the first four (in this case) input pulses reaching the base of Q8 cannot cause the transistor to conduct and are effectively ignored. By the time of the fifth pulse, however, the Q8 emitter potential has been reduced by the charging of C12 to a value only slightly greater than that of the base. This fifth pulse therefore raises the Q8 base potential above that of the emitter, triggering conduction in Q8 and beginning the next cycle. (Triggering in this case on the fifth rather than the fourth, sixth, etc. pulse is determined by the C12/R20 time constant.)

In a similar manner, the next divider Q9/Q10 receives the one microsecond output pulses of the first divider and divides by five again, producing a 4 kpps output. The third divider Q12/Q13 divides this 4 kpps by two, and Q15/Q16 divides the resulting 2 kpps pulse train by five. The fifth divider divides the 400 pps output of the fourth divider by two, producing a 200 pps output. The 4 kpps output of the second divider is fed by the buffer amplifier Q11 to a pulse-steering network for use in the derivation of one of the synchronous detector driving signals. The 2 kpps output of the third divider is fed to the binary flip-flop Q23/Q24 and to Assy 599591 through buffer amplifier Q14. Q19 is a buffer amplifier that serves to supply the 200 pps output of the fifth divider to Assy 599591 .

The -5 volt regulated voltage required by the pulse-type frequency dividers is furnished by the regulator consisting of Q20, Q21 and Q22. The regulated -10 volt supply is used both as a power source and a voltage reference.

The 2 kpps output of the third divider, buffered by Q14, is fed to the binary flip-flop Q23/Q24. This flip-flop then produces two 1 kc/s square waves, 180° out of phase, at the collectors of the two transistors. One of these square waves, buffered by Q25 and Q26, serves as the coherent 1 kc/s output and the 1 kc/s 90° signal which drives the phase error synchronous detector.

The 4 kc/s pulses from Q11 are steered by a gate consisting of C19, R49 and CR3 to the base of Q27 and another gate consisting of C20, R51 and CR4 to the base of Q28. The gates controlled by the binary flip-flop Q23/Q24 force the output of the binary Q27/Q28 to be a 1 kc/s square wave, lagging binary flip-flop Q23/Q24 by 0.25 msec or 90°. This 1 kc/s 0° square wave is buffered by Q29 and Q30 and fed to Unit 599-300, where it drives the AGC synchronous detector.

b. VCO/Control Loop I (Assy 599590)

See Figure 6-2 and Drawing 599198 in Chapter X

The voltage controlled oscillator incorporating Q22, Q23 and Q24 serves as the local oscillator for the Digital Synthesizer. Operation of this VCO is

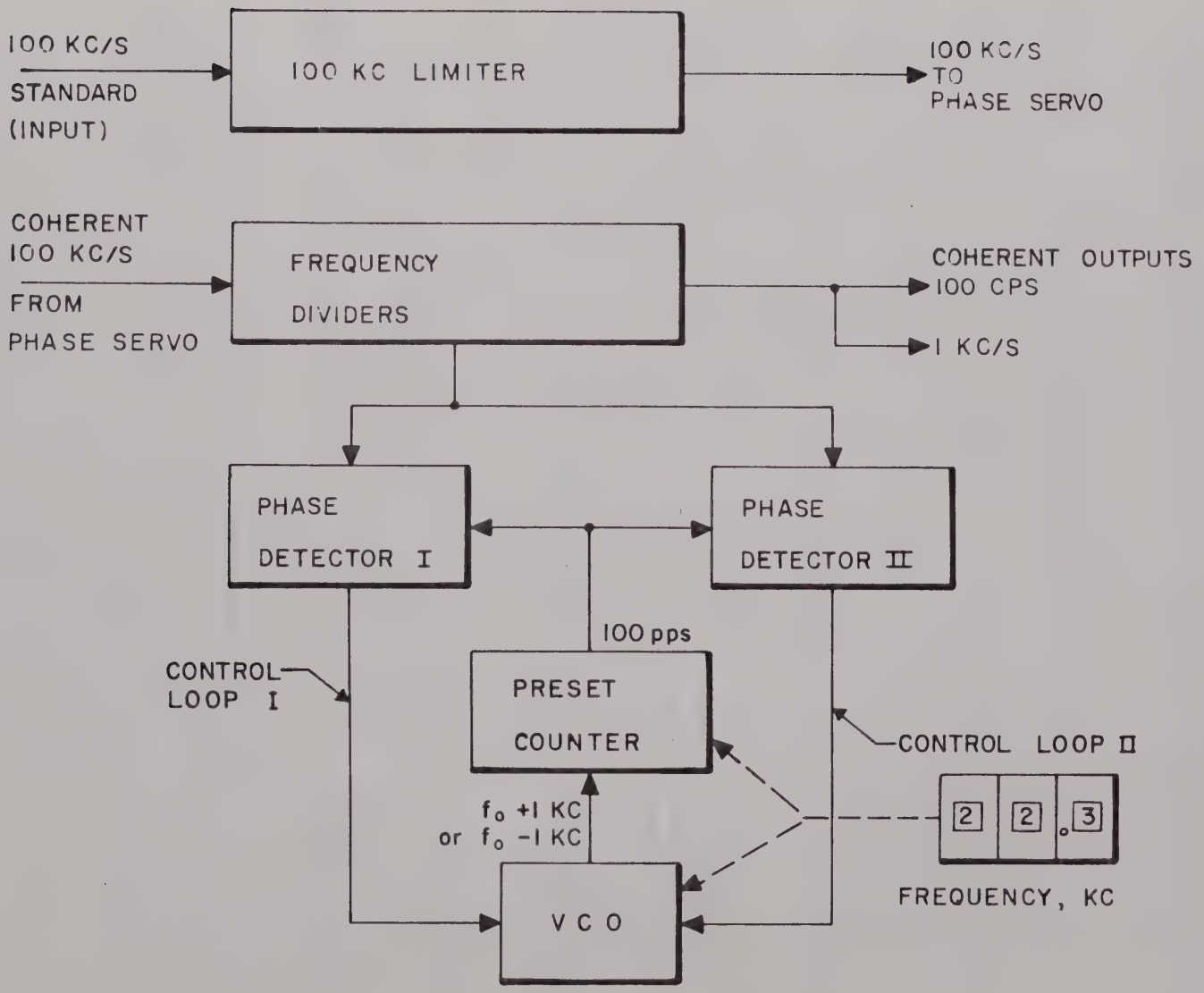


Fig 6-1 SIMPLIFIED BLOCK DIAGRAM DIGITAL SYNTHESIZER

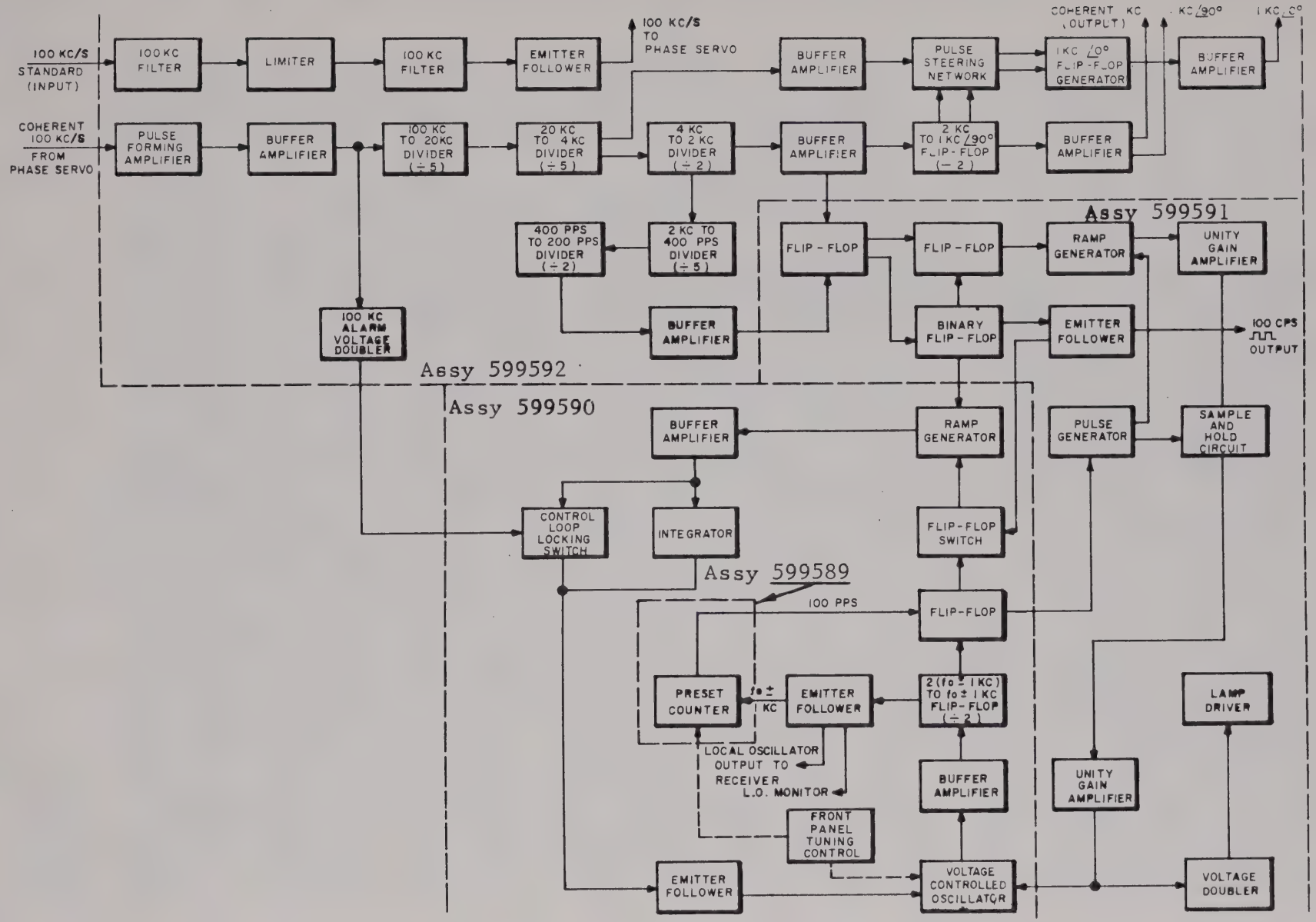


Fig. 6-2. DETAILED BLOCK DIAGRAM OF DIGITAL SYNTHESIZER

much like the operation of the pulse-type frequency dividers mentioned previously; Q23 and Q24 in the VCO function in exactly the same manner as Q7 and Q8 in the first divider of Assy 599592. Control loop I provides a voltage that controls the conduction state of Q22. Q22 in turn controls the frequency of the VCO. The second control loop provides a voltage that sets the potential at the base of Q23.

The VCO output frequency is set by the digital tuning switch and ultimately by the control loops at $2(f_o \pm 1 \text{ kc/s})$ where f_o is the frequency of the station to which the receiver is tuned. This output is then amplified by common-emitter amplifier Q20 and fed to the binary flip-flop Q17/Q18. This flip-flop divides the VCO output by two. The resulting $f_o \pm 1$ kc/s square wave appearing at the collector of Q17 is the local oscillator output and is transmitted by emitter follower Q19 to the Receiver. The Q19 output is also transmitted to the back panel to provide for monitoring of the local oscillator. The output of Q19 is also coupled to the flip-flop Q14/Q15 (Assy 599590) and to the preset counter of Assy 599589 for subsequent processing by the control loops.

The VCO is controlled by two control loops. The effects of these two loops on the VCO are related, but for purposes of this discussion it may be said that control loop I controls the "coarse frequency" and the "very fine phase" of the VCO. Control loop II then controls the VCO in the area between the "coarse frequency" and the "very fine phase." In the operation of both loops, the phase of a signal derived from the VCO output is compared with that of a reference signal. Error voltages are then generated on the basis of the comparisons and these voltages are used to control the VCO. The reference used in these comparisons is a 100 cps square wave derived from the external frequency standard. The signal derived from the VCO is the VCO output divided in frequency by 1/100 of the desired VCO frequency. Thus, if the VCO frequency is correct, the frequency of both of the signals being compared will be exactly 100 cps. The VCO-derived signal to be compared to the 100 cps square wave is supplied by the preset counter on Assy 599589 . This circuit divides the $f_o \pm 1$ kc/s local oscillator output by $\frac{f_o \pm 1 \text{ kc/s}}{100}$. The preset counter output is then used to set the flip-flop Q14/Q15. The local oscillator output is used to reset the flip-flop. By using the output of this flip-flop in place of the preset counter output, the effects of time delay in the preset counter are eliminated.

The digital tuning switch performs two functions. First, it connects certain leads within the preset counter to an "and" gate within that counter, setting the preset counter to divide the local oscillator output by $\frac{f_o + 1 \text{ kc/s}}{100}$ if the "AB" switch is in the "A" position and $\frac{f_o - 1 \text{ kc/s}}{100}$ if the "AB" switch is in the "B" position. Second, it connects a certain combination of resistors to provide coarse tuning of the VCO.

Control loop I, which is located on Assy 599590 , incorporates a ramp generator, an integrator, and a flip-flop switch as its primary components. The ramp generator is controlled by the 100 cps square wave reference signal and, with the help of the flip-flop switch, the preset counter output. The integrator then integrates the ramp output to provide the loop I control voltage.

The ramp generator consists of Q2, which serves as a current source; C4, a storage capacitor; and Q1, a switch used to discharge C4. The binary incorporates Q3 and Q4. A 100 cps square wave with a phase angle of 180° is fed to the base of Q1, and a 100 cps square wave with a 0° phase angle is fed to the flip-flop input at the base of Q3. The output of the preset counter (corrected for time delay) is supplied to the flip-flop switch input at the base of Q4.

An operational sequence begins when the 100 cps signal at 0^{o} goes negative. This negative step, transmitted by CR1 to the base of Q3, causes Q3 to cut off. Q4 therefore conducts, causing Q2 to conduct in turn. At the instant that the 100 cps 0^{o} signal went negative, the 100 cps 180^{o} signal went positive. This in turn caused Q1 to conduct. When Q2 begins conduction, the current it supplies is returned to ground through Q1. After 5 milliseconds, the 100 cps 180^{o} signal goes negative. This negative step is then transmitted by C3 to the base of Q1, cutting Q1 off. Q1 is held off during the entire time that the 100 cps 180^{o} signal is negative by the long C3/R28 time constant. At this time Q2 begins to charge C4 very rapidly. If permitted to do so, C4 will quickly charge to approximately +10 volts and hold this charge. If the VCO is on frequency, however, the charge on C4 (and consequently the maximum ramp amplitude) will be terminated at approximately +5 volts.

When the Q14/Q15 flip-flop is reset, the collector of Q14 goes negative. This negative step, transmitted through CR2 to the base of Q4, causes Q4 to cut off. This in turn causes Q2 to cut off, terminating the charging of C4.

If the VCO is on frequency, the output signal from the preset counter will be exactly 100 pps. (The preset counter divides the VCO output by $\frac{f_o \pm 1 \text{ kc/s}}{100}$.) The preset counter output, if on frequency, will also terminate the ramp (stop the charging of C4) at approximately +5 volts. This charge will then remain on C4 until the 100 cps 180^{o} signal causes Q1 to conduct again, beginning another cycle. Continuing with the operation of the control loop, the ramp generator output is transmitted by the buffer amplifier Q5/Q6 to a finite memory integrator. The integrator, composed of a differential amplifier having a capacitive feedback loop, then performs a simple integration of the input signal. (The differential amplifier incorporates Q9, Q10, Q11 and Q12; the capacitive feedback loop is made up of C10 and C11.) Balance of the amplifier is achieved when the input to the integrator (at the base of Q9) is approximately 2.5 volts. The output of the integrator is transmitted through the voltage divider composed of R52, R53 and R55 to emitter-follower Q13. The emitter-follower in turn transmits the signal through the VCO "coarse frequency" resistance to a large capacitor (C25) in the biasing circuit of Q22. This loop I control voltage, impressed across C25, then controls the emitter-base of Q22. Q22 in turn controls the charging rate of C22, thus controlling the VCO as discussed previously.

If the VCO frequency is low, the output of the preset counter will allow C4 to be charged to increasingly higher potentials on successive charging cycles. The average value of the ramp generator output is now greater than when the VCO frequency was correct. But due to the inversion in the integrator, the integrator's output will be less than it was when the VCO was on frequency. This diminished output then brings about a proportional reduction in the voltage across C25. The emitter potential of Q22 is thus reduced, causing Q22 to conduct harder. C22 is therefore charged more rapidly and the VCO output frequency is increased.

The loop locking switch, incorporating Q7 and Q8, receives the positive dc output of the voltage doubler of Assy 599592 when the 100 kc/s reference frequency is present. This voltage holds Q7 in saturation, keeping Q8 cut off. But if the 100 kc/s reference is lost, the voltage doubler output is lost, Q7 cuts off, and Q8 conducts. Conduction of Q8 causes the feedback capacitors of the integrator to be shorted out. The output of the differential amplifier in the integrator is therefore returned to its input. The integrator output goes to about 2.5 volts and remains there, locking control loop I.

c. Control Loop II (Assy 599591)

See Figure 6-2 and Drawing 599199 in Chapter IX.

Generation of the loop II ramp is controlled by the same 100 cps reference frequency that controls the ramp of loop I. At the same time the loop I ramp is stopped, the loop II ramp voltage is sampled and held. The loop II voltage is supplied to the emitter of Q23 to control the VCO. To provide bilateral control of the VCO, the loop II ramp is sampled near its midpoint when the VCO is on frequency. Generation of the loop II ramp must start before that of the loop I ramp to make this possible. Since both ramps must be controlled by the same reference, the signal which controls the loop II ramp must be dependably delayed and then used to control the loop I ramp.

Three flip-flops, incorporating transistors Q1 through Q4 and Q6 through Q7 on Assy 599591 , are used to derive the ramp control voltages. The first flip-flop Q1/Q2 is fed with 2 kpps and 200 pps pulses from the frequency dividers. This flip-flop then produces outputs at the collectors of Q1 and Q2 as shown in Figure 6-3. The 200 pps positive, half-millisecond pulses provided at the collector of Q1 are applied to the binary flip-flop Q3/Q4. The output at the collector of Q4 is given a phase of 180° and fed by voltage divider R10/R11 to control loop I. The second output, having a phase angle of 0°, is transmitted by emitter-follower Q5 to control loop I and to the back panel as the coherent 100 cps output. The third flip-flop Q6/Q7 is supplied with the 100 cps 0° signal from the collector of Q3 and with 200 pps negative, half-millisecond pulses from the collector of Q2. It then generates an output at the collector of Q6 as shown in Figure 6-3. This Q6 output is used to start the generation of the ramp of control loop II.

Q8, Q9 and C16 make up the ramp generator in the operation of control loop II. Q8 serves as a current source that charges C16, and Q9 serves to discharge C16 when the Q6 collector voltage is at its most positive value; Q8 assumes a nonconducting state; Q9 discharges C16; and C14 charges to the difference in the Q9 emitter base voltage drop and the Q6 collector potential. When the Q6 collector goes negative, Q8 breaks down, keeping the base voltage of Q8 constant. Charging of C16 (ramp generation) is begun at this time, and the charging will continue until the voltage across the capacitor approaches that of the positive supply. The charge on C16 will remain at this value until the Q6 collector goes positive again, cutting off the current source and discharging C17 through Q9. The C14/R33 time constant is long enough to prevent Q9 from conducting during ramp generation.

The voltage across C16 is fed by the unity gain amplifier incorporating Q12, Q13, Q14 and Q15 to the sampling switch Q16/Q17. At an output from the preset counter, the monostable multivibrator Q10/Q11 will momentarily stop the ramp generator and cause the sampling switch trigger Q18 to conduct. At this time the sampling switch will permit the value of the charge on C16 to be transmitted to C20. The voltage across C20 is then transmitted to another unity gain amplifier (Q19, Q20, Q21 and Q22) to the base of Q23 on Assy 599590 , where it controls the VCO.

A typical operational sequence begins when a positive pulse output from the preset counter is transmitted through C19/CR9 (Assy 599591) to the base of Q10, causing Q10 to conduct. (Q10 is normally held in a nonconducting state by normally saturated Q11). As a result, the collector of Q10 goes negative. This negative transition is then transmitted by CR8 to the emitter of Q8, halting the generation of the ramp, and by C15 to the base of Q11, turning Q11 off. The new potential at the collector of

Q11 is then transmitted by R40 to the base of Q10 and by R45/R46 voltage divider to the base of Q18. The condition is maintained until Q11 once again begins to conduct on completion of the redistribution of charge on C15. During the time that Q18 is conducting, the bases of Q16 and Q17 are lowered from a potential very near 10 volts to a potential very near ground. This in turn biases Q16 and Q17 for conduction. Then, while the ramp is stopped, the charge on C16 is transmitted by the unity gain amplifier mentioned previously through either Q16 or Q17 (depending upon the relative charge on C16 and C20) to C20. The second unity gain amplifier then transmits the voltage on C20 to the VCO.

If the VCO frequency is too high, the voltage across C20 (Assy 599591) will be low. This voltage, when applied to the VCO, will cause the VCO frequency to be lowered. If the VCO output is too low, the voltage across C20 will be high, and the VCO frequency will be raised accordingly.

When the VCO frequency is correct, the voltage appearing across C20 will be the same on each successive cycle of operation.

The loop II control voltage is applied to a voltage doubler as well as to the VCO. This doubler incorporating C22, CR11, CR10 and C23, is used to indicate whether loop II has locked the VCO on frequency. If the VCO is not locked on the desired frequency, the loop II control voltage will vary. This will cause the voltage doubler to provide a positive voltage at the base of Q24. This, in turn, will cause Q24 and Q23 to conduct. Q23 collector current then flows in the indicator, causing it to light. When the VCO is locked on frequency, there is no voltage doubler output, and the indicator remains unlighted.

NOTE: In the 599-202 Receiver, the Lamp Driver Q23/Q24 is not used (Alarm Lamp is not used) but is included and explained because Assy 599591 is also used in the 599-102 Digital Synthesizer where the Lamp Driver is required.

d. Preset Counter (Assy 599589)

See Figure 6-4 and Drawing 599200 in Chapter IX.

As stated in previous sections, the preset counter of Assy 599589 accepts the local oscillator output and divides this signal by $\frac{f_o \pm 1 \text{ kc/s}}{100}$ where f_o is the frequency to which the receiver is tuned. The counter is of the binary coded decimal type, and uses binary flip-flop shift registers. Presetting of the counter is accomplished with the three thumb-wheel switches of the digital tuning switch. Setting of these switches connects all the stages of the counter which should be in the "1" state when the desired count is reached at an "and" gate. The output of this "and" gate is fed, in turn, to a reset generator. The reset generator then resets the counter to either 10 or -10 (depending upon the setting of the "AB" switch) each time the preset count is reached.

The output of the local oscillator is transmitted by C2 to the first stage of the tenths shift register. This stage, incorporating Q1 and Q2, is a binary flip-flop. The stage is in the "0" condition when Q1 is conducting and the stage output (at the collector of Q1) is highly negative. A "1" is registered when Q1 is cut off and the stage output is in a less negative condition.

All other counter stages are like the first stage. Each negative transition of the first stage causes the second stage to change state, etc. The second and fourth stages of the tenths register are connected to the "and" gate consisting of CR3, CR4, R34 and C18. When a count of ten (0101) is reached, both of these stages

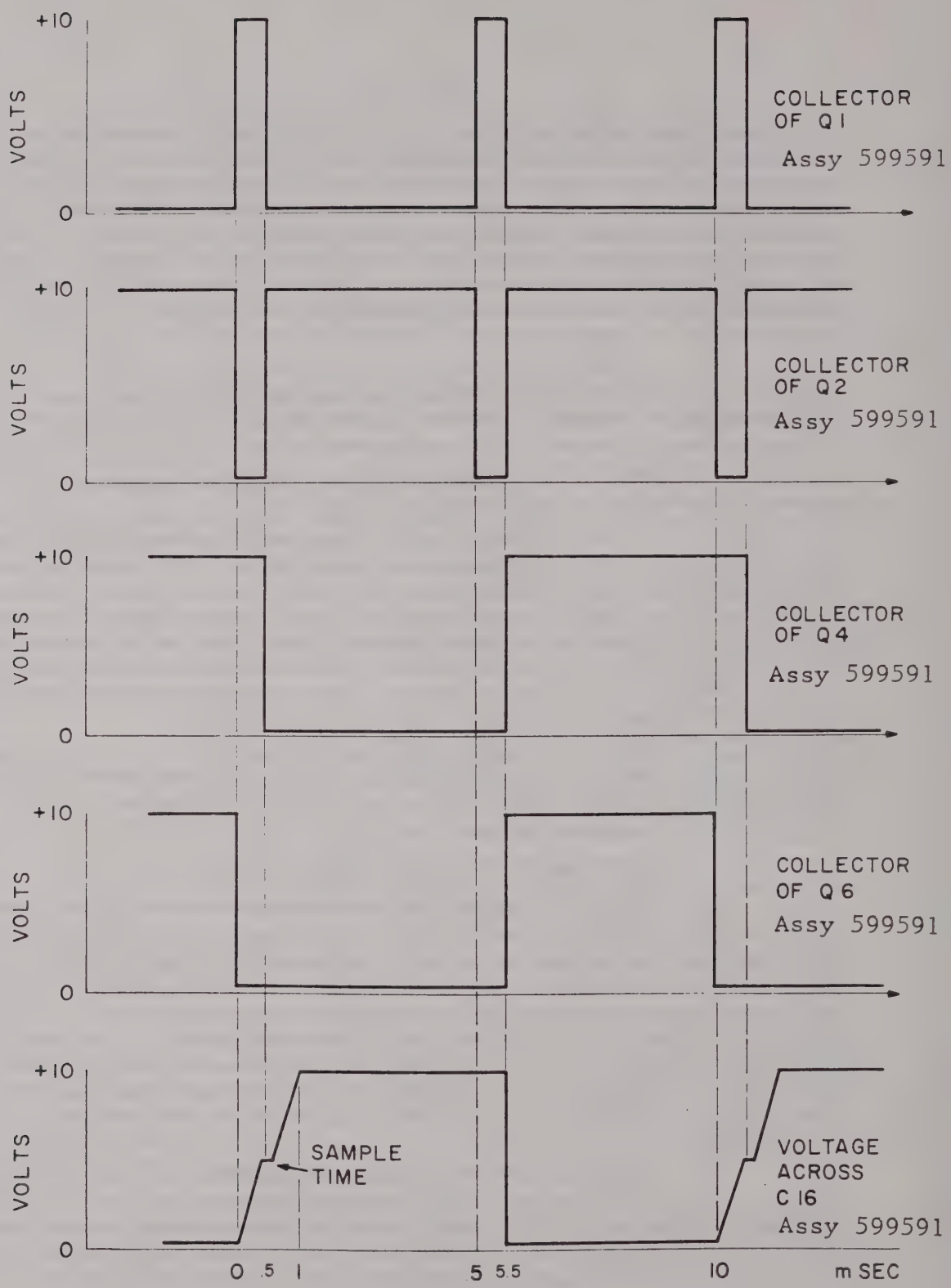


Fig. 6-3 COLLECTOR WAVEFORMS

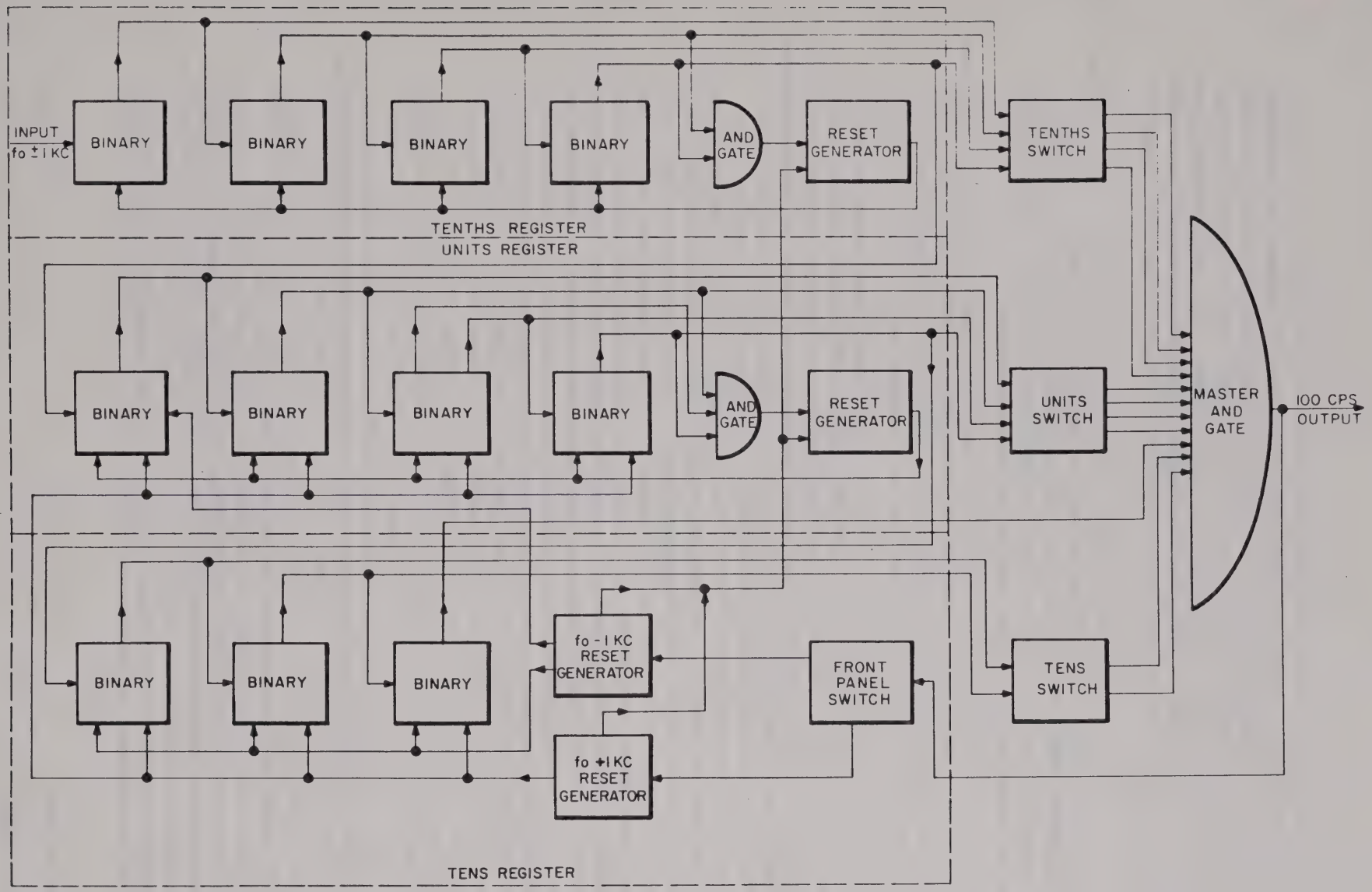


Fig. 6-4 DETAILED BLOCK DIAGRAM OF PRESET COUNTER, Assy 599589

will register "1's" causing the "and" gate to provide a positive voltage at the base of Q9. This will cause Q9 to conduct, and its collector to go negative. Q20 then transmits this negative potential to the base of Q10, causing Q10 to cut off. As a result, the collector of Q10 goes positive. This positive voltage step is then applied to the bases of Q1, Q3, Q5 and Q7 to set the four stages of the tenths register back to the "0" condition. The Q10 collector voltage is also fed through R40 back to the base of Q9. This serves to hold Q9 in conduction until the charge on C20 is redistributed and Q10 is cut off.

At the time the tenths register is reset, and only at this time, the output of the fourth stage of the register goes negative. This output is coupled through C21 to the input of the first stage of the units register. The units register receives an input pulse each time that the tenths register is reset. Operation of the units register is identical to that of the tenths register.

Operation of the tens register varies slightly from that of the tenths and units registers, as it consists of only three stages. The register operates in the same manner as the other registers, but only the first two stages take part in counting. The third register serves a purpose discussed later.

The outputs of the tenths register pass through diodes CR1, CR2, CR22 and CR7, which make up part of the master "and" gate, to the tenths thumb-wheel switch. This switch the connects to a common point the outputs that must register "1" when the desired count is reached. In the same manner, the outputs of the units register pass through diodes CR8, CR14, CR15 and CR16 (also parts of the master "and" gate) to the units thumb-wheel switch. This switch in turn connects to a common point the outputs that must register "1" when the desired count is reached. Likewise, the outputs of the first two stages of the tens register are connected through diodes CR17 and CR18 to the tens switch where the process described above is carried out. The common points of the three switches are then connected to a point between R104 and C51, two of the three remaining components of the master "and" gate. The final component of the master "and" gate, CR19, connects the complement output of the third stage of the tens register to the "and" gate. This means that all outputs connected to the master "and" gate by the thumbwheel switches must register "1" and the third stage of the tens register must register "0" before the master "and" gate will deliver an output. When these conditions are met, the master "and" gate will cause the base of Q27 to go positive. This will in turn cause Q27 to conduct, taking its collector negative. This negative transition is transmitted by Q53 to the base of Q28 if the "AB" switch is in the "A" position and to the base of Q29 if the "AB" switch is in the "B" position.

If the "AB" switch is in the "B" position, the negative potential cuts off Q29, taking its collector positive. This positive potential then performs the following functions:

(1) It is fed through CR23 and R106 back to the base of Q27. This serves to hold Q27 in conduction until the charge on C53 is redistributed and Q29 is cut off.
(2) It is applied through CR23, C54, R117 and CR6 to the reset generator of the tenths shift register and through CR23, C54, R118 and CR13 to the reset generator of the units shift register. Here the potential serves to trigger the reset generators, setting the two registers to "0".
(3) It is fed directly to the bases of Q21, Q23 and Q25, where it sets the three stages of the third register to "0"

(4) Finally, it is fed through R114 to the base of Q30. Here the potential serves to set the Q11/Q12 counter stage to "1". First, the units reset generator attempts to set the Q11/Q12 stage to "0" at the same time the Q29 collector voltage attempts to set the same stage to "1". This is due to the fact that the C53/R111 time constant is greater than the C39/R77 time constant. The purpose in setting this stage to "1" is to place a count of $\frac{1 \text{ kc/s}}{100}$ into the counter before the counting is begun. As a result the counter will count to the desired $\frac{f_o - 1 \text{ kc/s}}{100}$ instead of $\frac{f_o}{100}$.

If the "AB" switch is in the "A" position, the negative potential from Q27 will cut Q28 off, taking its collector positive. This positive potential, in turn, performs a second set of functions:

(1) It is fed through CR21 and R106 back to the base of Q27. This serves to hold Q27 in conduction until the charge on C53 is redistributed and Q28 is cut off.
(2) It is applied through CR21, C54, and CR6 to the reset generator of the units shift register. Here the potential serves to trigger the reset generators, setting the register to "0".
(3) It is fed to the bases of Q12, Q14, Q16, Q18, Q22, Q24 and Q26. This serves to set all stages of the units and tens register to "1". As with the previous case, the units reset generator attempts to set all stages of the units register to "0" while the collector voltage of Q28 attempts to set the same stages to "1". Again, each stage is finally set to "1" because the C53/R110 time constant is greater then the C39/R77 time constant.

When all stages of the units and tens register are set to "1", the counter registers the count shown below:

Tenths	Units	Tens
0000	1111	111

After a count of $\frac{1 \text{ kc}}{100}$, the counter will turn over (all registers will reset to zero). Therefore, by setting all stages of the units and tens registers to "1's" the counter is effectively set to $\frac{-1 \text{ kc}}{100}$. The purpose in setting all stages of the units and tens register to "1" is to place a count of $\frac{-1 \text{ kc}}{100}$ into the register before the counting is is begun. Then, the counter will count to the desired $\frac{f_o + 1 \text{ kc}}{100}$ instead of $\frac{f_o}{100}$.

In order for the preset counter to operate in the manner just described, the counter design makes allowance for two special conditions. First, setting of all stages of the units register to "1" would normally cause the units reset generator to be triggered (since the second and fourth stages would register "1's"). To prevent this from happening, the complement output of the third stage, at the collector of Q16, is fed to CR10 and the units register "and" gate. Thus for the units register to be reset, its second and fourth stages must register and its third stage must register a "0". The second special conditions concerns cases where the receiver might be tuned to some frequency such as 11.1 kc/s. The master "and" gate would deliver an output when a "1" was registered by the first stage of each register. When the "AB" switch is in the "A" position, the first stages of the units and tens registers are automatically set to "1" before the count is begun. Under these conditions, the counter would deliver an output pulse after one count, for at that time the first stage of all three counters would register "1". This is prevented by the third stage of the tens register.

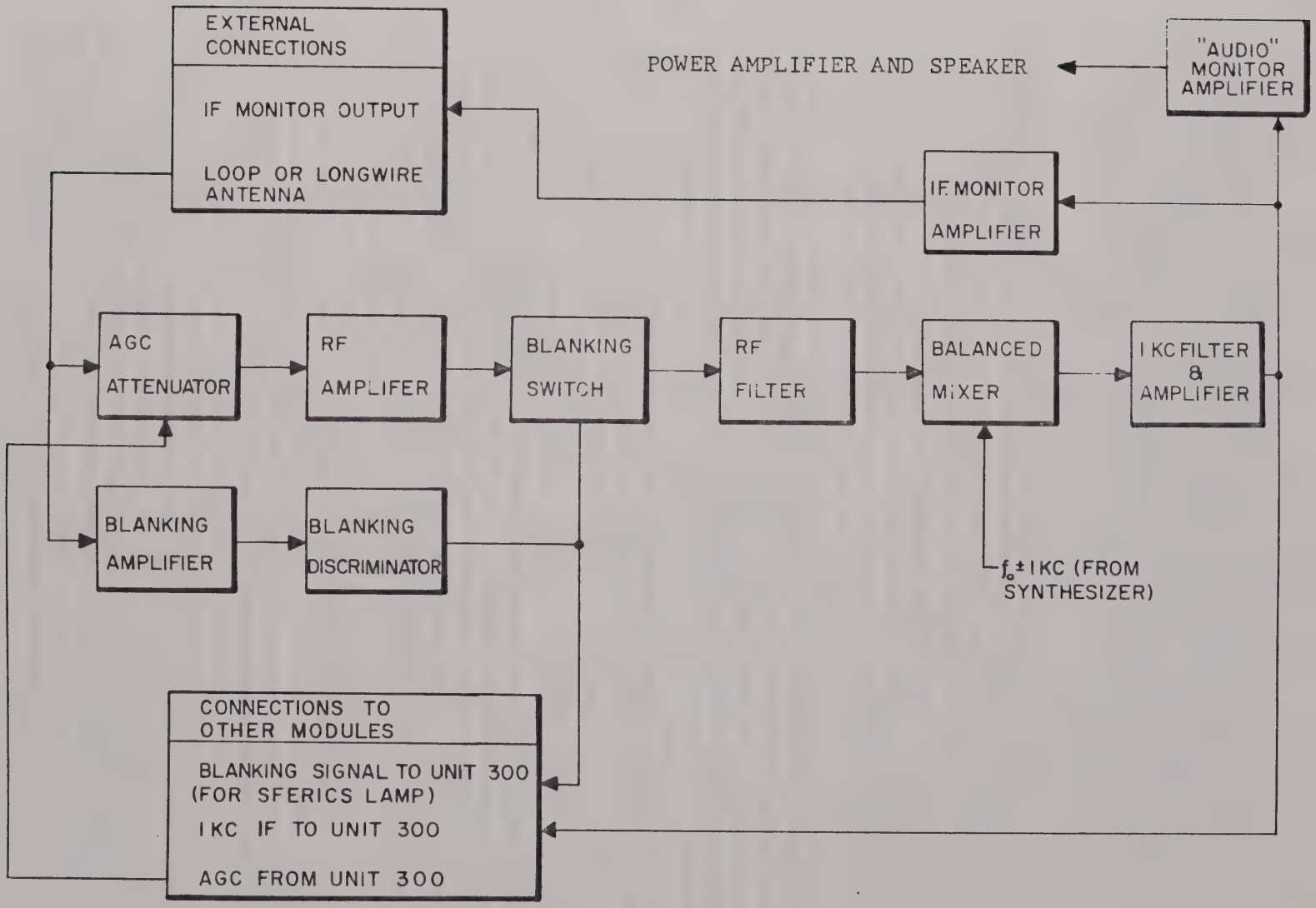


Fig. 6-5. BLOCK DIAGRAM OF RECEIVER MODULE

2. Receiver (Assy 599568)

See Figure 6-5 and Drawing 599201 Chapter IX.

a. AGC Attenuator and RF Amplifier

RF carrier energy entering the receiver is transformed from a 50 ohm impedance level at the input terminal to a 500 ohm level by T1. The input amplifier, which incorporates Q1, Q2 and Q3, serves the purpose of:

providing gain at the carrier frequency,

terminating the source antenna appropriately,

providing (through the action of CR1) an electronically controllable phase-stable gain characteristic, and,

driving the following RF filter from an appropriate impedance.

AGC Control is achieved by making use of the conductivity modulation characteristics of a semiconductor diode. CR1, a fast recovery computer diode, exhibits an ac conductance that is roughly proportional to the dc bias current supplied to it by the AGC Phase Unit, Unit 599-300. CR1 may accordingly be considered a variable resistance connecting the base of common emitter amplifier Q1 to ground. When the bias current in CR1 is small, CR1 is essentially open-circuited and full gain is realized from the amplifier. If, however, the bias current is high, most of the carrier input current passes through CR1 to ground and the net gain of the RF amplifier stage is relatively small. A stable input termination impedance is provided by this circuit: when CR1 is open-circuited, degenerative feedback through R1 lowers the input impedance of Q1 to approximately 500 ohms and when CR1 is essentially short-circuited by high values of bias current, the input termination is supplied chiefly by R2. At intermediate values of CR1 bias, the action of the circuit continues to provide an input termination very near 500 ohms.

b. Blanking Switch

NPN symmetric switching transistor Q4 is normally in saturation, providing continuity between the output of the RF Amplifier and the input of the RF Filter. In the blanking mode of the operation, the beginning of an impulse of noise results in removing the base bias that saturates Q4, disconnecting the RF Filter input for the duration of the impulse. Sensing of the impulse and formation of the base gating pulse are discussed below.

c. RF Filter

The STATION switch selects a 1 kc/s Twin-T notch filter in position ALL or a 3-pole series input-series output bandpass filter with a Butterworth response in Positions A through D. The Twin-T composed of R15, R16, R17, C1, C2 and C3 (on the module chassis) passes frequencies between 10 kc/s and 30 kc/s and rejects any 1 kc/s signal picked up by the RF amplifier, antenna cable or antenna. The bandpass filter is used when necessary to attenuate an image frequency, or when signal to noise ratio is low.

d. IF Monitor Amplifier

An emitter follower Q18 and a common base stage Q19 provide gain and isolation to amplify the IF output for monitoring purposes.

e. Mixer

The filtered carrier appears at the wiper of the ATTENUATION switch. Emitter follower Q11 transmits the carrier at a low impedance to mixer Q14, a PNP

symmetric switching transistor. Local osillator injection voltage from the Digital Synthesizer is applied at the base of Q14, alternately saturating Q14 and open-circuiting it; i.e., alternately connecting R29 to and disconnecting it from carrier voltage at the emitter of Q11. Very little of the injection voltage at the base of Q14 appears at its emitter, so that Q14 acts essentially as a balanced modulator. The Local Oscillator injection voltage frequency is offset from the carrier by 1 kc/s; the resulting modulation product at 1 kc/s is amplified by Q15, filtered at 1 kc/s by the 1 kc/s IF Filter, and amplified again by Q16 and Q17. The output of the 1 kc/s amplifier at the emitter of Q17 drives the AGC and Phase Error Synchronous Detector driver stages in AGC Phase Unit

f. Blanking Amplifier

Atmospheric and other noise impulses are amplified by Q5, pass through the Blanking Level Control, and are further amplified and converted to a differential output by emitter-coupled amplifier Q6/Q9.

g. Blanking Discriminator

Normally Q7 and Q8 are held in a nonconducting condition by their base potentials. When an impulse occurs that is large enough to bias Q7 or cause Q8 to conduct, C13 discharges. The voltage across C13 drops and Q10, no longer supplied with emitter bias through R19, turns off. When Q10 turns off, the base at Q4 is no longer supplied with a bias current, Q4 turns off, and disconnects the R. F. filter from the R. F. amplifier, so that the impulse cannot enter the R. F. filter.

h. Audio Converter and Amplifier (Assy 599552)

A free running unijunction oscillator consisting of Q5, R13, R14, R15 and C5 generates a signal of approximately 4.2 kc/s that is divided down to approximately 2.1 kc/s by the flip-flop (Q3, Q4 and associated components). The 2.1 kc/s signal is then fed to a balanced mixer (Q1, Q2 and T1) and is mixed with the coherent 1 kc/s IF signal from the receiver IF amplifier to produce the sum and difference frequencies 3.05 and 1.05 kc/s respectively. A filter consisting of L1, C6 and C7 rejects the 3.1 kc/s component and passes the 1.k kc/s component to emitter follower Q6.

The output of Q6 drives a push-pull emitter coupled Class A power amplifier (Q7 and Q8). Transformer T2 couples the output of the amplifier to the loudspeaker.

B. AGC Phase Unit 599-300 (Assy 599626)

See Figure 6-6 and Drawing 599393 in Chapter IX.

1. AGC Channel

a. AGC Synchronous Detector Driver and Synchronous Detector

Further amplification of the carrier at 1 kc/s intermediate frequency is accomplished by Q314 and Q315, emitter-coupled amplifiers operating push-pull into a common load, T301B. To accomplish coherent detection of the carrier for gain control purposes, the output of the secondary of T301B is commutated at a 1 kc/s rate (divided from the 100 kc/s standard as explained in the Digital Synthesizer Section of Unit 599-202) by Q316 and Q317, respectively PNP and NPN symmetric switching transistors. Filtering of the commutated output is performed by C307 and C307A. In normal operation this synchronous commutation or "phase detection" of the carrier produces an average output voltage at J-599597, which is proportional (neglecting sign) to the carrier level A-599597

b. The dc Amplifier and Filter

The synchronous detector output appearing at J-TB302 is amplified and filtered by a dc amplifier employing Q318, Q319, Q320 and Q321. Filtering with a time constant of approximately 250 seconds is accomplished in this amplifier by means of

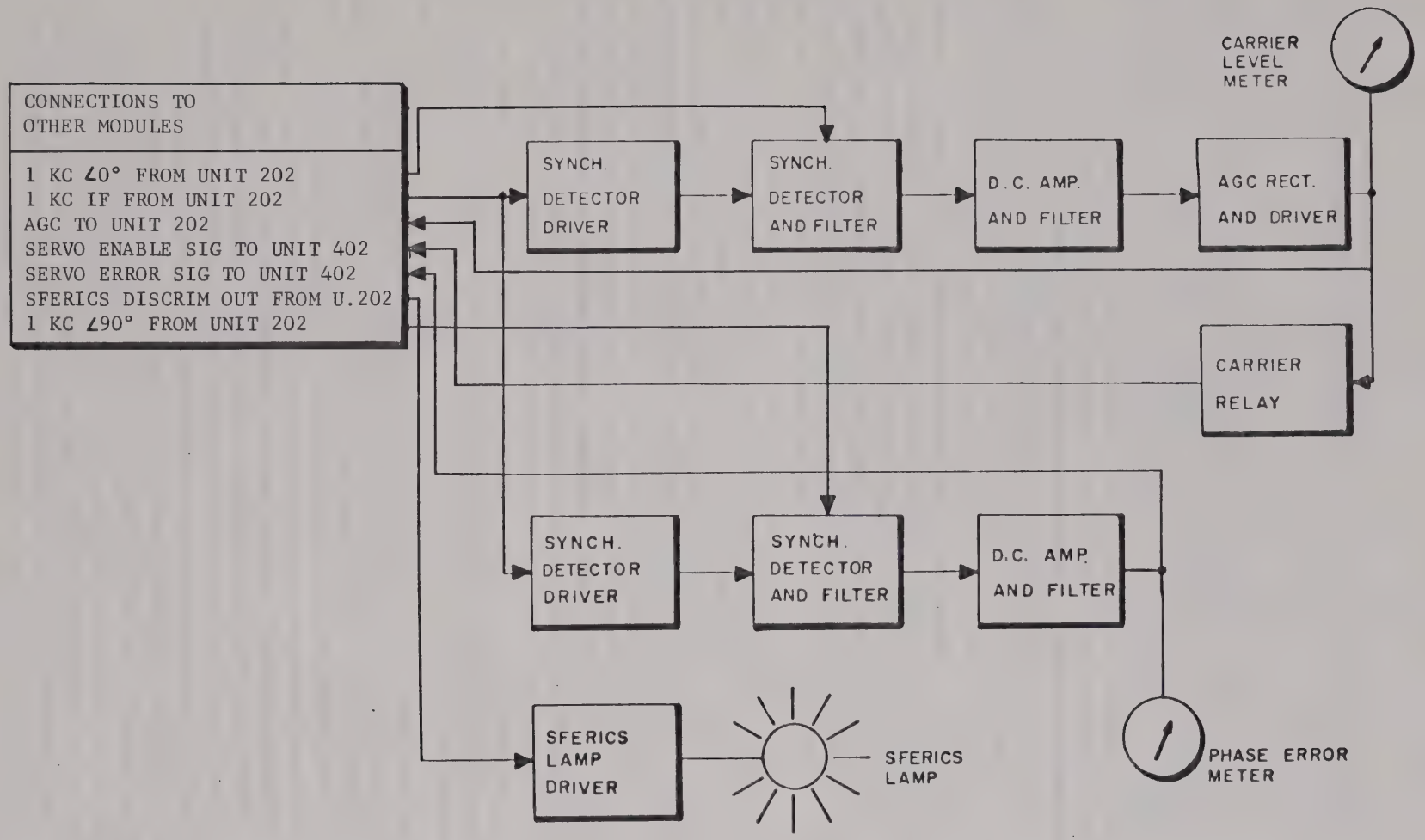


Fig. 6-6. AGC-PHASE ERROR AMPLIFIER (UNIT 300)

feedback through C310 to the base of Q320. Provision is made for a longer time constant by the installation of a C318. This is not recommended without technical consultation with TRACOR.

c. AGC Rectifier and Driver

In normal operation of the receiver, the detected carrier at J-599597 may be positive or negative depending upon the phasing of the 1 kc/s reference signals to the AGC and Phase Synchronous Detectors. To allow for normal operation under both of those alternatives, the output of the AGC amplifier is rectified by diodes CR302 and CR303. Detector carrier J-599597 produces a balanced differential output between DD-599597 and T-599597 A threshold established by R355 provides a delay in the onset of AGC action: the potential at the wiper of R355 is adjusted to be approximately 1.5 volts below the equilibrium voltage at DD and T when the voltage J-599597 remains at zero.

When the detector carrier level at J-599597 is large enough to bring DD-599597 or T-599597 (as the case may be) below this potential, current flow from the base of AGC driver Q322 through one of the AGC rectifier diodes. The resulting collector current in Q322 flows principally in AGC attenuator diode CR201 in Unit 599-202 Receiver, producing an appropriate attenuation of the carrier at that point. A portion of this current is used to turn on Q324 and Q325 to actuate carrier level indicator DS301. The voltage across the carrier level meter is amplified by transistors Q14, Q15, Q16 and Q17 to provide a dc signal for external recording of carrier level. (The carrier level amplifier is on Assy 599596.)

2. Phase Error Channel

This circuit is identical to that described in AGC Channel above. In this case, however, 1 kc/s reference is at quadrature with the carrier input so that the voltage at J-599596 normally averages zero.

Deviations of this voltage from zero are amplified by a dc amplifier incorporating Q4, Q5, Q6, Q9 and Q10. The output of the amplifier is limited by feedback zener diodes VR1 and VR2. The output of the amplifier drives the electronic servo, phase error meter, and record connector output.

C. Electronic Servo, Unit 599-402 (Assy 599394)

Refer to Figure 6-7

The phase error signal from the AGC/Phase module is integrated and then inverted by appropriately connected operational amplifiers. The outputs of the integrator and of the inverting amplifier are applied to a level detector, which triggers a monostable multivibrator if either output exceeds a certain threshold. The monostable multivibrator drives the bi-directional mechanical counter and the transistor switches that reset the integrator. The mechanical counter is steered (a count is added or subtracted) by the output levels of the integrator and the inverting amplifier immediately before the monostable multivibrator is triggered. This section of the electronic servo is a voltage-to-frequency converter. The output of the integrator is a sawtooth signal with a polarity opposite to the error signal and with a frequency proportional to the magnitude of the error signal.

In the second part of the electronic servo, the external frequency standard signal is limited and then filtered by a crystal filter to provide a 1 Mc signal. The 1 Mc signal is divided to 100 kc/s and then delayed a nominal 3 μsec by a delay generator. The output of the delay generator "rings" a 10 Mc crystal filter, producing a constant amplitude

10 Mc signal. The delay generator is controlled by the output of the integrator. A change of the integrator's output from zero to the resetting threshold will change the delay of the delay generator by 0.1 μsec, which is one cycle of a 10 Mc signal. The output of the crystal filter can "follow" the relatively slow phase changes of the delay generator except when the integrator is being reset. Because the crystal filter's ringing time is long compared to the integrator's resetting time and the phase change is exactly one cycle, the 10 Mc output of the crystal filter will hold constant during the integrator reset time. The crystal filter is a "flywheel" used to preserve both phase and amplitude of the 10 Mc signal during the integrator reset time.

The phase-shifted 10 Mc signal is divided to drive a 100 kc/s flip-flop and also to drive 10 and 100 μsec full scale linear phase comparators. The linear phase comparators are binaries that are set by the phase-shifted signal and reset by an unshifted signal. The rectangular outputs of the binaries are filtered and provide full scale outputs equal to the period of their input pulses.

1. Assy 599569 (see Drawing 599392 in Chapter IX)

The integrator is made up of an operation amplifier consisting of transistors Q18, Q19, Q20, Q21, Q25 and Q26; resistor R38; capacitors C19 and C20; and resetting transistors Q22, Q23 and Q24. The output of the integrator is inverted by another operational amplifier consisting of Q27, Q28, Q29 and Q30 connected as a unity gain inverting amplifier. The outputs of the integrator and the inverting amplifier are compared to the threshold voltage (nominally 2.5 VDC), which is stabilized by VR5, at the junction of R67 and R68. If either output exceeds the threshold, Q31 or Q32 will conduct, biasing Q34 off. The collector of Q34 will go negative, turning Q35 off. Q35 and Q34 form a monostable multivibrator with an unstable state of 25 milliseconds duration. When Q35 turns off, the monostable multivibrator is triggered, and its output resets the integrator through driver Q37 and resetting transistors Q22, Q23 and Q24. As soon as the reset process is started, the outputs of the integrator and inverter drop below the resetting threshold, turning Q31 or Q32 off and turning Q34 on, which allows normal operation of the monostable multivibrator. In normal operation the emitter of Q45 is returned to +10 VDC through R100, keeping Q45 turned off. When it is desired to "lock" the servo (for instance, because the VLF carrier is off the air), R100 is disconnected from the +10 VDC by the carrier relay in the AGC/Phase module, and on the next resetting pulse Q37 and Q45 will both latch on. The collector current of Q37 keeps the resetting transistor on until Q37 and Q45 are turned off by reconnecting R100 to +10 VDC.

The emitter current of Q36 is amplified by Q46 and Q43 to drive the mechanical counter. Emitter follower Q44 provides -10 VDC for Q43 from the negative unregulated power supply.

The collector current of Q43 is steered to the count-up or count-down coils of the counter by the binary consisting of Q39 and Q40 and the differential amplifier consisting of Q41 and Q42. If the output of the integrator is positive, Q42 and Q40 will be on and Q41 and Q39 will be off. If the output of the inverting amplifier is positive, then Q41 and Q39 will be on and Q42 and Q40 off. At the time the integrator is reset, either Q39 or Q40 will be on and will stay on during the time of the reset pulse, steering the collector current of Q43 through the correct coil in the counter. The emitter follower Q38 supplies +10 VDC to Q39 and Q40 from the unregulated positive supply. Resistors R96 and R97 and diodes CR6 and CR7 damp the induced voltage when the current in the counter coils is turned off.

The 1 Mc or 100 kc/s external frequency standard signal is limited by Q1 and Q2. Positive feedback from the collector of Q1 to the base of Q2 improves switching speed. The square wave collector current of Q2 produces pulses across L1,

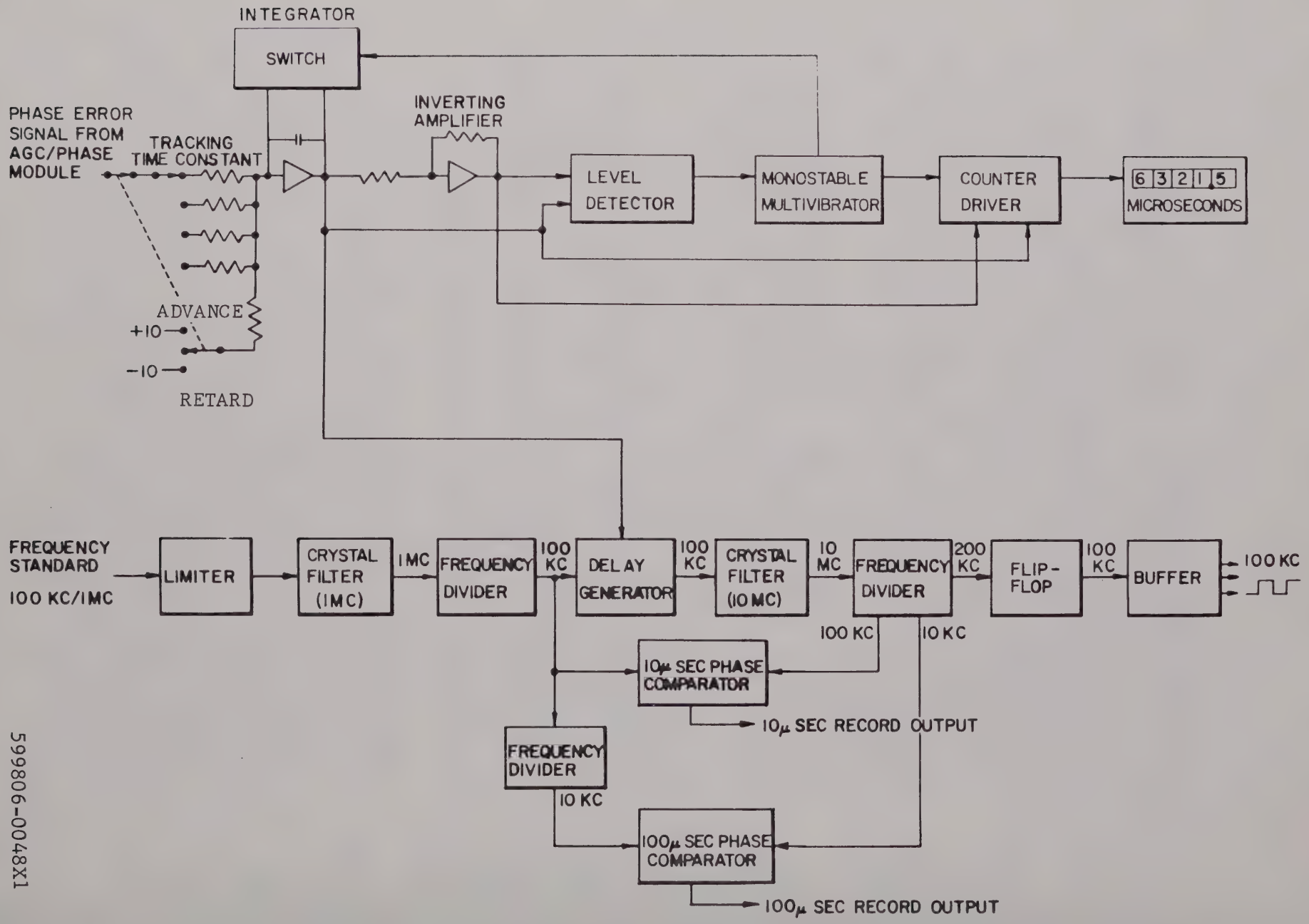


Fig. 6-7. ELECTRONIC SERVO, UNIT 402

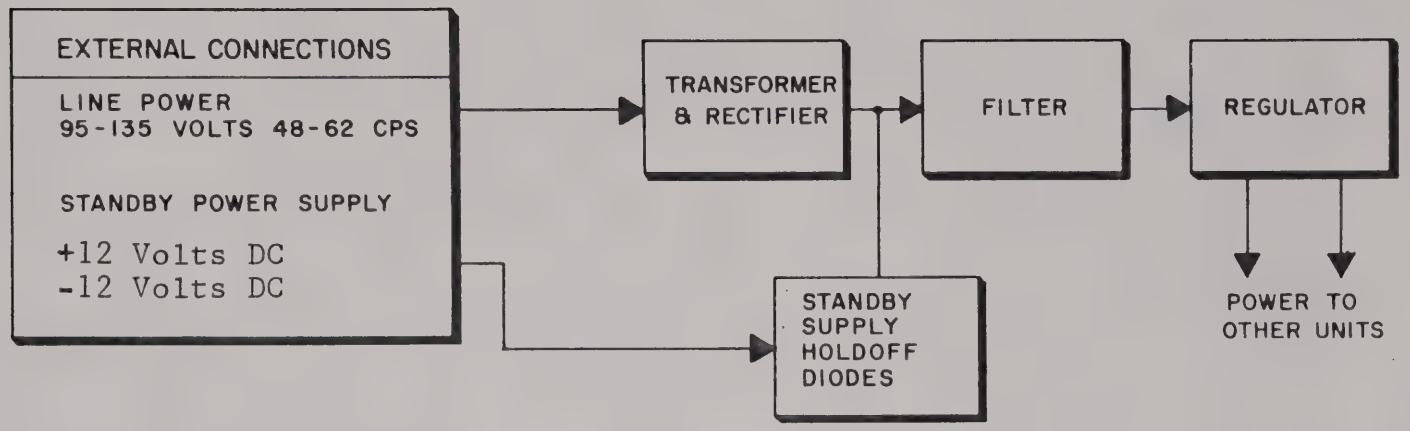


Fig. 6-8. POWER SUPPLY, UNIT 502

which turns Q3 on for a few tenths of a microsecond at the same frequency as the external frequency standard signal. The voltage across C5 will be a sawtooth with the same frequency as the external frequency standard. The 1 Mc harmonic of the sawtooth is filtered by crystal filter Y1 and then limited by Q4, Q5 and Q6 to form 1 Mc pulses. The 1 Mc signal is then divided by pulse dividers, which are identical to those used in the digital synthesizer (see section VI.A.1 of this chapter).

Regulator Q11/Q12 supplies -5 VDC to all of the pulse-type frequency dividers in the electronic servo.

The 100 kc/s pulses from the base of Q9 are delayed about 3 μsec by a monostable multivibrator consisting of Q14 through Q17. In the monostable multivibrator's normal state, Q15 is off and Q17 is on. The pulses from the base of Q9 turn Q15 on, which then turns Q17 off until C15 discharges enough to turn Q17 back on. A constant current source, Q16, is used to discharge the capacitor. The output of the integrator is attenuated by R103, R85 and R37 to control Q14 and VR1, which clamp the collector voltage of Q15 and cause the delay to be varied by the output of the integrator. The output of the delay generator is a negative-going, variable width pulse about 3 μsec long.

2. Assy 599570 (see Drawing 599396 in Chapter IX)

During the time the delay generator is in the unstable state, Q1 is on, charging L1. At the end of the unstable state, Q1 is rapidly turned off, allowing L1 and C2 to ring at about 10 Mc. The damped oscillation is buffered by Q2, filtered by Y1, and then amplified and limited by Q3, Q4 and Q5 to produce 10 Mc pulses. The 10 Mc pulses are divided by pulse-type dividers to 200 kc/s, 100 kc/s, and 10 kc/s pulses. These pulse-type dividers are similar to those in the Synthesizer, described on page 6-1 of this manual.
The 200 kc/s pulses are buffered by Q22 and then frequency-divided by the flip-flop composed of transistors Q23 and Q24. The 100 kc/s square wave output of the flip-flop is buffered by emitter-followers Q25, Q26 and Q27 to provide phase-shifted 100 kc/s outputs. The 100 kc/s unshifted signal from Assy 599564 is divided to 10 kc/s. The phase-shifted and unshifted 10 kc/s pulses are compared by a binary consisting of Q34 and Q29. The output of Q29 is buffered by Q30 and then amplified by Q31 and Q36. Filters consisting of R82/C46 and R86/C47 provide a dc output voltage that is proportional to the phase shift and has a full-scale range of 100 μsec. The phase-shifted and unshifted 100 kc/s pulses are compared by the binary consisting of Q33 and Q32. The output of Q32 is buffered by Q35 and then amplified by Q37 and Q28. The outputs of Q37 and Q28 are filtered by R102/C45 and R91/C34 to provide dc outputs proportional to the phase shift and with a full-scale range of 10 μsec.

D. Power Supply, Unit 599-502 (Assy 599723)

Refer to Figure 6-8 and Drawing 599726 in Chapter IX.

1. Transformer, Rectifiers, and Filters

Line power is supplied to the receiver through transformer T1, and rectified and filtered to provide unregulated positive and negative supply voltages by diodes CR3, CR4, CR5 and CR6 and filter capacitors C6 and C7.

2. Regulator Circuits

Two separate regulator circuits provide stabilization of the positive and negative supply voltages used by the remainder of the receiver.

Zener diodes VR1 and VR2, connected in series, provide a reference voltage for stabilizing the +10 volts (vernier adjustment is accomplished by R3).

The difference (error) between the zener reference voltage and the positive regulated voltage is amplified by the differential pair (Q3 and Q4). The amplified error drives the emitter follower, Q8, that in turn drives the series regulator, Q2.

The negative regulated supply voltage is obtained in the same way except that in this case the regulated positive voltage supplies the reference through a voltage divider composed of R7 and R8.

3. Standby Battery Holdoff Diodes

In normal line operation, the unregulated supply potentials exceed the standby battery voltages so that holdoff diodes CR7 and CR8 are biased "off." Should line power fail, CR7 and CR8 will conduct, providing uninterrupted regulated power. DS2 is energized by Q7 when line power fails.

VII. SERVICE INSTRUCTIONS

A. Recommended Test Equipment

The following equipment is used in servicing the instrument:

1. Oscilloscope, Tektronix Model 531 or 545, with Type H plug-in unit or equivalent.
2. Probe, 10:1 attenuation, Tektronix Model P6000 or equivalent.
3. Volt Ohmmeter (VOM), RCA WV-38A or equivalent.
4. Two 16 terminal jumper cables, supplied with unit.
5. 24 terminal jumper cable, supplied with unit.
6. 100 kc/s (or 1 Mc) local frequency standard.
7. 22 pin PC board extender, supplied with unit.

B. Adjustment Procedure

Components in the instrument have been chosen for stability and long life, and the receiver should operate for very long periods with no readjustment at all. In spite of the long expected life of the transistors and other components in the unit, components may fail or may in some cases change in time so that replacement is necessary. Because of the variation in transistors, replacement of certain transistors in the receiver may require readjustment of the affected section. Adjustment procedures for circuits critical in this respect are described in the following section. It is recommended that no readjustment be attempted unless an actual fault occurs. Those areas where adjustment may be necessary upon replacement of components are:

1. Power Supply, Voltage, Unit 599-502.
2. The 100 kc/s to 200 cps Divider, Unit 599-202, Assy 599592.
3. The Chart Recorder, Unit 599-202.
4. Phase Error DC Amplifier, Unit 599-300.
5. AGC DC Amplifier, Unit 599-300.
6. Delay Generator, Unit 599-402, Assy 599569.
7. 1.0 Mc Crystal Filter, Unit 599-402, Assy 599569
8. 10 Mc Crystal Filter, Unit 599-402, Assy 599570
9. AGC Record Amplifier, Unit 599-302, Assy 599596
10. Frequency Dividers, Unit 599-402.

These are discussed in detail below.

1. Adjustment of the Regulated DC Voltage Level in Power Supply, Unit 599-502.
   a. Connect Unit 599-502 into J5 by means of a 24 terminal jumper cable. All other modules should be in place to provide normal operating load.
   b. Connect a VOM (RCA WV-38A or equivalent) to terminal P (+) and terminal G.
   c. Switch LINE to ON. The LINE pilot lamp should light; adjust R3 so meter reading is +9.8 volts dc.

d. If standby batteries are connected, switch STANDBY to READY, then switch LINE to OFF. STANDBY lamp should light when LINE is OFF and no change should be noticed in VOM reading.

e. Switch LINE to ON.

f. Disconnect VOM "+" lead (switch meter to -vdc range or reverse leads) and reconnect to terminal N. The meter reading must not be more negative than -10 vdc.

g. If standby batteries are connected, repeat step (d).

2. Adjustment of 100 kpps to 200 pps Divider, Unit 599-202, Assy 599592

a. Connect Unit 599-202 into Chassis Frame with two 16 terminal jumper cables.

NOTE: Each jumper cable must connect the connectors which are mated when the 599-202 receiver is installed in the chassis frame. Reversing the connection between the two connectors will DAMAGE the 599-202 receiver.

b. Connect an oscilloscope (Tektronix 531 or equivalent) through a 10:1 probe to TP6 on Assy 599592.

c. Switch LINE to ON.

d. Adjust R46 so that waveform has a period of 5.000 millisec.

e. Turn R46 clockwise until period changes. Then while counting turns, adjust R46 counterclockwise until the period again changes (the number of turns should be greater than 6); set R46 clockwise one-half the number of turns.

3. Adjustment of Chart Recorder, Unit 599-202

a. Connect Unit 599-202 into Chassis Frame with two 16 terminal jumper cables.

NOTE: Each jumper cable must connect the connectors which are mated when the 599-202 receiver is installed in the chassis frame. Reversing the connection between the two connectors will DAMAGE the 599-202 receiver.

b. Actuate the record ZERO pushbutton on the back panel. Adjust the screw behind the removable plug on the recorder so that recorder reads zero.

c. Actuate the record FULL SCALE pushbutton on the back panel. Adjust R14 (located directly behind recorder) so that recorder reads 100.

4. Adjustment of the Phase Error DC Amplifier, Unit 599-300

a. Disconnect Antenna cable and set ATTENUATION to 80 db.

b. Switch LINE to ON and wait thirty seconds.

c. Adjust R13, BALANCE on Unit 599-300 front panel, so that PHASE ERROR meter reads exactly zero.

5. Adjustment of the AGC DC Amplifier, Unit 599-300

   a. Disconnect R346 from circuit at S-599597.

   b. Connect Unit 599-300 into J3 by means of a 24 terminal jumper.

   c. Disconnect Antenna Cable and set ATTENUATION to 80 db.

   d. Switch LINE to ON and wait thirty seconds.

   e. Connect VOM (RCA WV-38A or equivalent) between terminals DD and T on 599597. Adjust R342 so that indicated potential is zero.

   f. Switch LINE to OFF and reconnect R346 into the circuit. Cover the adjustment screw of R342 with inspection dope.

6. 10 Mc Crystal Filter, Unit 599-402, Assy 599569

   a. Connect Unit 599-402 into Chassis Frame with 24 terminal jumper cable.

   b. Connect oscilloscope (Tektronix 531 or equivalent) to base of Q3.

   c. Switch LINE to ON.

   d. Adjust L1 and C3 for maximum 10 Mc on base of Q3.

7. Adjustment of the Delay Generator, Unit 599-402, Assy 599569.

   a. Connect Unit 599-402 into Chassis Frame with a 24 terminal jumper cable.

   b. Connect oscilloscope (Tektronix 531 or equivalent) to collector of Q5 on Assy 599570. Trigger the oscilloscope with 100 kc/s from the external frequency standard.

   c. Connect collector of Q324 to ground in AGC/Phase module.

   d. Switch LINE to ON.

   e. Set time constant switch to 15 seconds and unbalance phase error amplifier so that servo has a rate of about 0.1 μsec per second.

   f. Adjust R103 on Assy 599569 for minimal lurching of 10 Mc whenever the MICROSECONDS counter changes.

8. AGC Record Amplifier, Unit 599-302, Assy 599597

   a. Connect Unit 599-302 into Chassis Frame with 24 terminal jumper cable.

   b. Connect VOM (RCA WV-38A or equivalent) to terminal 15 on RECORD OUTPUT connector and ground.

   c. Switch LINE to ON. Set ATTENUATION, DB to 80 db. Wait until CARRIER lamp comes on.

   d. Adjust R33 on Assy 599569 so that meter reads zero.

9. 1.0 Mc Crystal Filter, Unit 599-402, Assy 599569

   a. Connect Unit 599-402 into Chassis Frame with 24 terminal jumper cable.

   b. Connect oscilloscope (Tektronix 531 or equivalent) to TP-3.

   c. Switch LINE to ON.

   d. Adjust C7 for maximum 1 Mc signal on base of Q4.

10. Frequency Dividers, Unit 599-402, Assy 599569 and Assy 599570

   a. Connect Unit 599-402 into Chassis Frame with 24 terminal jumper cable.

b. Switch LINE to ON.

c. Connect an oscilloscope to the base of Q21 on Assy 599570. Adjust R26 so that the waveform has a period of 100 μsec. First turn R26 clockwise till the period changes. Then while counting turns, adjust R26 counterclockwise till the period again changes. Set R26 clockwise one-half the number of turns.

d. Connect the oscilloscope to the base of Q8 on Assy 599570. Adjust R20 so that the waveform has a period of 1.00 μsec. First turn R20 closkwise till the period changes. Then while counting turns, adjust R20 counterclockwise till the period again changes. Set R20 clockwise one-half the number of turns.

C. Trouble Shooting Aid

Many of the troubles encountered in operation of the instrument can be isolated to a particular circuit and consequently to a particular module by systematically checking the front panel and output operation. Familiarity with the block diagrams, Figures 6-1 through 6-8, is desirable for locating any malfunctioning circuit. This section will deal specifically with localizing the circuit presenting trouble. After location of the trouble area, reference can be made to the circuit description in Chapter VI. The waveforms are found at the end of this chapter.

In following the trouble shooting charts, when the symptom states no signal, this can mean no signal at all, signal distorted, or off frequency. Table 1 lists the characteristics of each output frequency that is available from rear chassis panel connectors. Table 2, Trouble Shooting Table, is to be followed in the sequence that it is written.

Table 1. Frequency Output Characteristics From Rear Chassis Panel Connectors

Output Connector	Waveform	Voltage Characteristics (minimum)
Coherent Outputs		
100 kc/s	Square Wave (Symmetrical)	1.0 vp-p
1 kc/s	Square Wave (Symmetrical)	0.8 vp-p
100 cps	Square Wave (Symmetrical)	0.5 vp-p
$f_o \pm 1$ kc/s	Square Wave (Symmetrical)	0.5 vp-p
IF Monitor Output	1 kc/s Sine Wave	Dependent on ATTENUATION Setting and AGC

Table 2. Trouble Shooting Table

a. Initial Conditions, Part 1

(1) Connect the 100 kc/s or 1 Mc LOCAL STANDARD.

(2) Do NOT track a station.

Symptom	Defective Component or Circuit
1. No CHASSIS OUTPUTS	POWER SUPPLY (Unit 502) LINE FUSES
2. No STANDBY operation	EXTERNAL STANDBY POWER SUPPLY STANDBY POWER FUSES STANDBY POWER CIRCUIT (Unit 502)
3. No COHERENT 100 kc/s OUTPUT	100 kc/s or 1 Mc LOCAL STANDARD ELECTRONIC SERVO (Unit 402)
4. No COHERENT 1 kc/s or 100 cps	DIGITAL SYNTHESIZER (Unit 202)

Table 2: Trouble Shooting Table (continued)

b. Initial Conditions, Part 2

(1) Tune the antenna for a station that is known to be broadcasting. Set the STATION switch (Unit 202) on the proper position.

(2) Set the DIGITAL SYNTHESIZER for desired frequency.

(3) Set ATTENUATION control to mid-range and VOLUME fully clockwise.

(4) Set BLANKING LEVEL fully counterclockwise.

(5) Allow three minutes warm up time.

Symptom	Defective Component or Circuit
1. No AUDIO OUTPUT, has IF MONITOR OUTPUT	AUDIO MONITOR AMPLIFIER (Unit 202)
2. No IF MONITOR OUTPUT, has AUDIO OUTPUT	IF MONITOR AMPLIFIER (Unit 202)
3. No IF MONITOR or AUDIO OUTPUT	Improper FILTER selected or defective FILTER AGC ATTENUATOR BLANKING SWITCH BLANKING DISCRIMINATOR and AMPLIFIER
4. SFERICS LAMP glows continuously	SFERICS LAMP circuit in AGC-PHASE module, if the lamp continues to glow with the RECEIVER module disconnected
5. MICROSECOND COUNTER does not operate	COUNTER DRIVE CIRCUITS, Assy 599569
6. PHASE ERROR meter does not indicate zero radians when ANTENNA is disconnected	PHASE ERROR SYNCHRONOUS DETECTOR, Assy 599596 PHASE ERROR DIFFERENTIAL AMPLIFIER, Assy 599596 (Attempt balance adjustment of R311)
7. CARRIER lamp does not extinguish when receiver is turned on and CARRIER LEVEL above -20 db	CARRIER LAMP CARRIER RELAY CIRCUIT
8. CARRIER LEVEL meter does not deflect full clockwise when unit initially turned on	AGC DIFFERENTIAL AMPLIFIER, Assy 599597 AGC RECTIFIER and DRIVER, Assy 599597 CARRIER RELAY CIRCUIT, Assy 599597 +10 and -10 volt power in AGC-PHASE MODULE

Table 2 (continued)

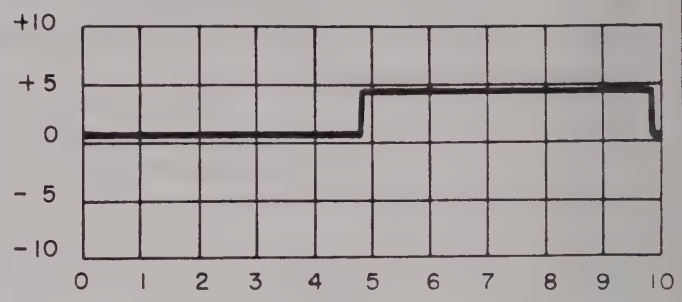
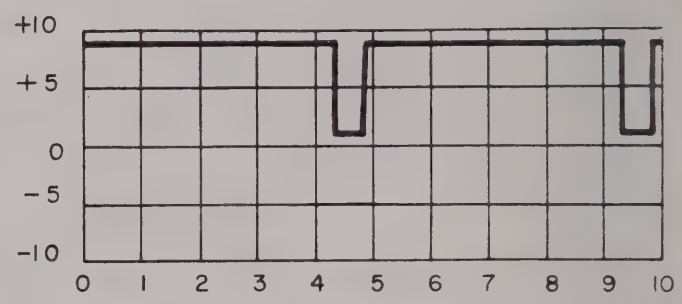
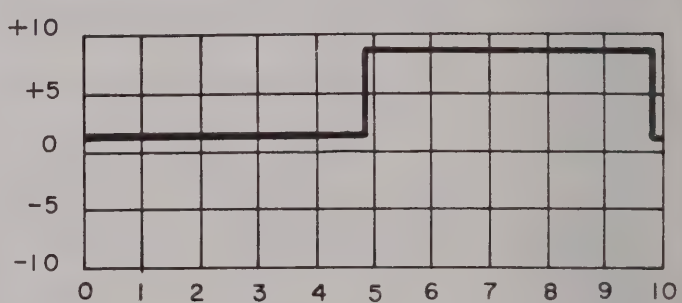
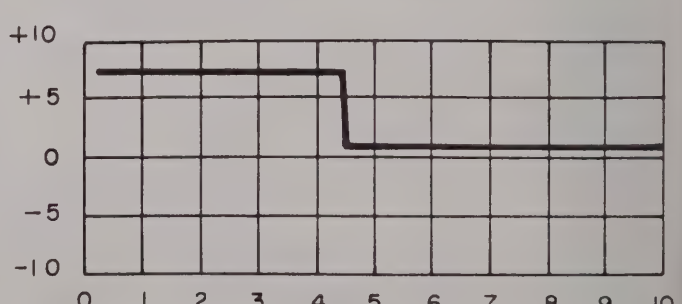
	Symptom	Defective Component or Circuit
9.	Receiver does not obtain carrier level when receiving a VLF station	Station is employing frequency shift keying or phase shift keying AGC SYNCHRONOUS DETECTOR, Assy 599597 AGC DIFFERENTIAL AMPLIFIER, Assy 599597
10.	Receiver will not indicate a phase error when set for normal tracking	PHASE ERROR SYNCHRONOUS DETECTOR, Assy 599596 PHASE ERROR DIFFERENTIAL AMPLIFIER, Assy 599596
11.	Receiver will not track with a stabilized CARRIER LEVEL	STANDARD FREQUENCY SOURCE has too large a fractional frequency offset
12.	RECORD OUTPUTS do not change when MICROSECOND COUNTER operates	PHASE COMPARATORS, Assy 599570
13.	No CARRIER LEVEL output	CARRIER LEVEL AMPLIFIER, Assy 599596

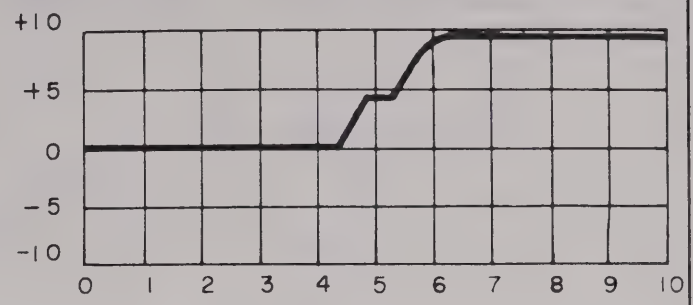
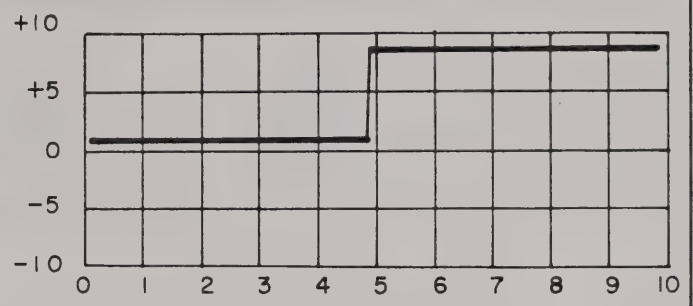
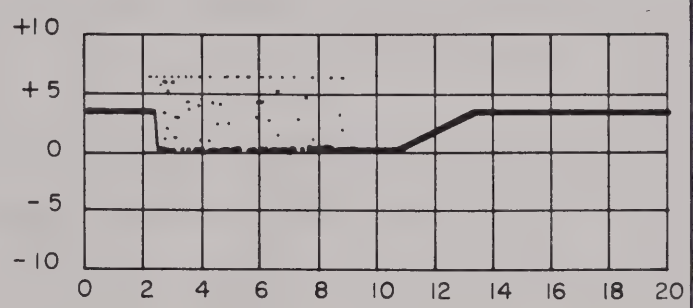
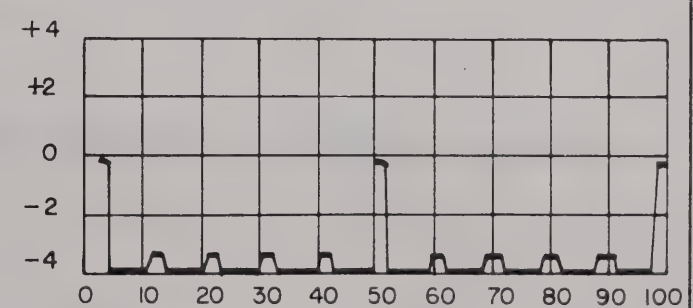
D. Factory Repair

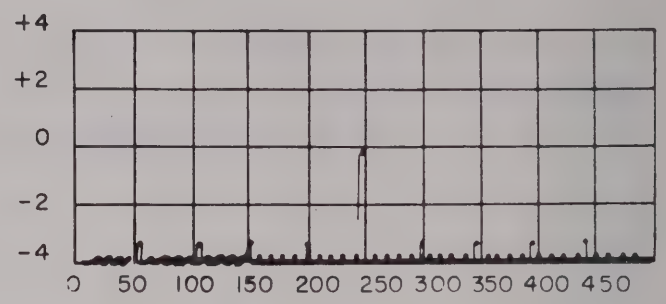
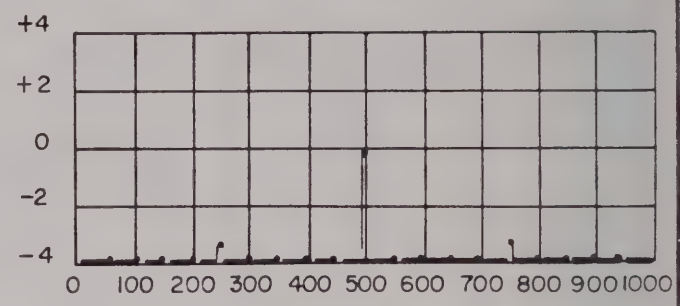
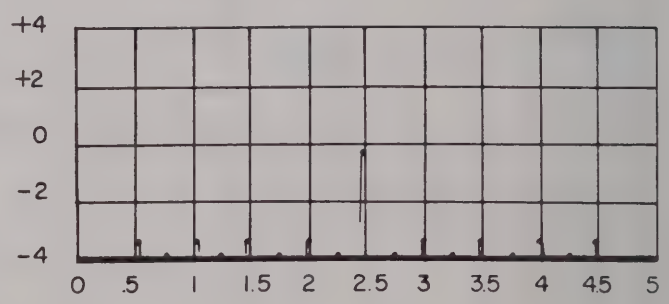
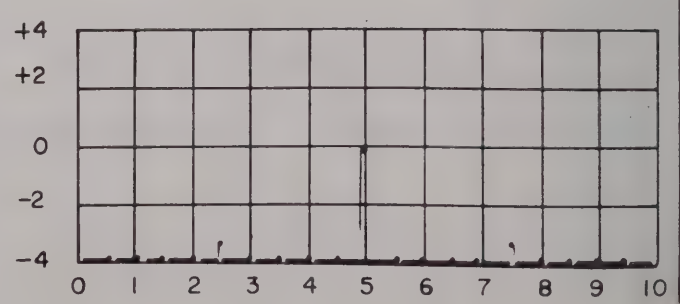
If the unit is returned for repair or maintenance to TRACOR, Inc., the complete receiver including all plug-in modules should be returned.

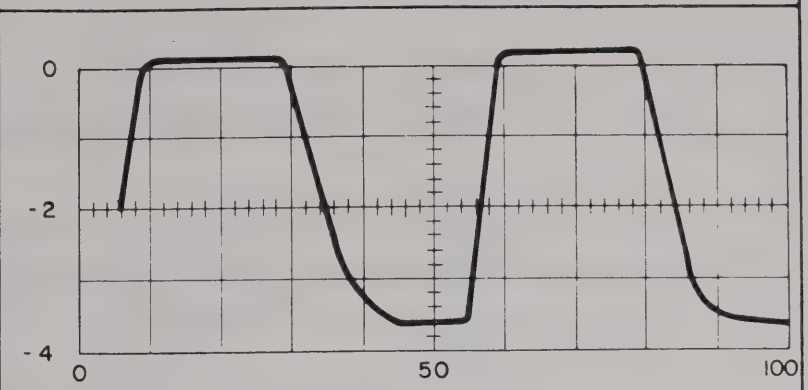
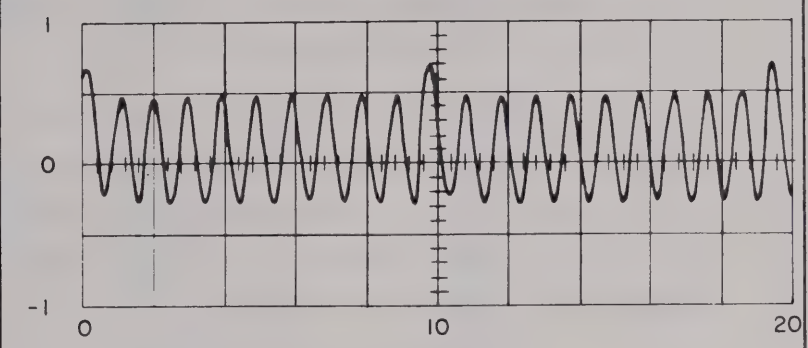
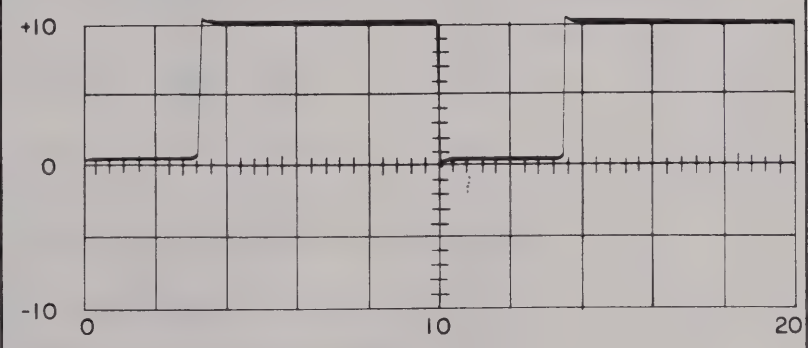
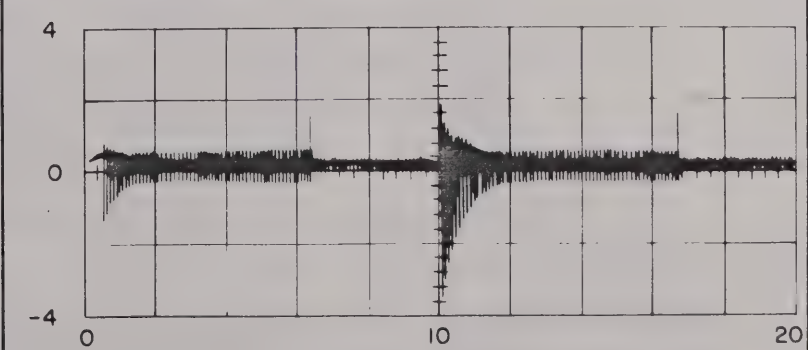
E. Waveforms

Waveforms appear on the following pages. Unless otherwise noted, the Synthesizer is set for 20 kc/s; Scope Input Selector (I.S.) is on DC; Trigger Slope (TS) is on INT; Scope Trigger Mode (TM) is on AC.

WAVEFORM NUMBER	TEST POINT	OSCILLOSCOPE SWEEP SPEED	NORMAL WAVEFORM
1.	Assy 599590 TP 3	1 MS/CM (INTERNAL TRIGGER)	
2.	Assy 599591 TP 1	1 MS/CM Trigger on Assy 599591 TP-3	
3.	Assy 599591 TP 2	1 MS/CM Trigger on Assy 599591 TP-3	
4.	Assy 599591 TP 3	1 MS/CM Trigger on Assy 599591 TP-3	

WAVEFORM NUMBER	TEST POINT	OSCILLOSCOPE SWEEP SPEED	NORMAL WAVEFORM
5.	Assy 599591 TP 4	1 MS/CM (INTERNAL TRIGGER)	
6.	Assy 599591 TP 5	1 MS/CM Trigger on Assy 599591 TP-3	
7.	Assy 599591 TP 6 (TUNE FROM 10.0 KC TO 10.9 KC)	2 SEC/CM (INTERNAL TRIGGER)	
8.	Assy 599592 TP 2	10 μS/CM (INTERNAL TRIGGER)	

WAVEFORM NUMBER	TEST POINT	OSCILLOSCOPE SWEEP SPEED	NORMAL WAVEFORM
9	Assy 599592 TP 3	50 μS/CM (INTERNAL TRIGGER)	
10	Assy 599592 TP 4	100 μS/CM (INTERNAL TRIGGER)	
11	Assy 599592 TP 5	0.5 MS/CM (INTERNAL TRIGGER)	
12	Assy 599592 TP 6	1 MS / CM (INTERNAL TRIGGER)	

WAVEFORM NUMBER	TEST POINT	OSCILLOSCOPE SWEEP SPEED	NORMAL WAVEFORMS
13.	Assy 599568 BASE OF Q 14 (f = 20.0 KC/S)	10 μSEC/CM.	
14	Assy 599569 TP 3	2 μSEC/CM.	
15.	Assy 599569 TP-6	2 μSEC/CM.	
16.	Assy 599570 TP 10	2 μSEC/CM	

VIII. TABLE OF REPLACEABLE PARTS

The following pages are divided into three sections: a Reference Designator Index, a List of Replaceable Parts and a key to the Manufacturer's Federal Code Number.

The Reference Designator Index delineates each part as to its Reference Designator Letter Number, its TRACOR Stock Number, its General Description and the number of the assembly to which the part is applied

The List of Replaceable Parts reiterates the TRACOR Stock Number and the General Description, but in addition furnishes the Manufacturer's Federal Code Number, the Manufacturer's Part Number, a Total Quantity column and a column indicating the number of Required Spares.

To order a replacement part from TRACOR, Inc., address your order either to your authorized TRACOR, Inc. Sales Representative or to:

Customer Service
TRACOR, Inc.
6500 Tracor Lane
Austin, Texas 78721

Specify the following information:

a. Model and serial number of the instrument.
b. Assembly or sub-assembly, from the part itself or from the heading of the pertinent section of the Reference Designator Index.
c. Circuit Reference Designator and TRACOR Stock Number, with a full description of the part obtained from the List of Replaceable Parts.

Part numbers as shown will change occasionally as manufacturer's items are re-evaluated, or as improved components become available. The equivalent component used in production at the time orders are received will be shipped.

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
			ASSY LOOP ANT CABLE	599168
1		3388-0028	CABLE COAX LG IN FT	599168
2		4196-0001	CONN BNC	599168
			ASSY PCB 22 PIN	599266
1		651-0017	NUT 6 32	599266
3		3326-0042	RIVET POP	599266
4		3326-0046	RIVET POP	599266
5		3805-0041	BOLT SPADE 6 32	599266
6		599195	BOARD PRINTED CIRCUIT	599266
7	A 1	599267	ASSY CONN	599266
2	P 1	3318-0028	CONN 22 PIN	599266
			CONNECTOR ASSY	599267
1		3318-5017	CONN 22 PIN	599267
2		3806-0001	CEMENT	599267
3		3806-0020	ACTIVATOR	599267
4		599786	BOARD CONN BARRIER	599267
			CABL ASSY 16PIN PATCH	599282
1		94-0025	TUBING SHRINKABLE	599282
2		95-0025	TUBING INSULATING	599282
3		705-0010	WIRE 22AWG BLK	599282
4		705-0110	WIRE 22AWG BRN	599282
5		705-0210	WIRE 22AWG RED	599282
6		705-0310	WIRE 22AWG ORN	599282
7		705-0410	WIRE 22AWG YEL	599282
8		705-0510	WIRE 22AWG GRN	599282
9		705-0610	WIRE 22AWG BLUE	599282
10		705-0710	WIRE 22AWG VIO	599282
11		705-0810	WIRE 22AWG GREY	599282
12		705-0900	WIRE 22AWG WHT/BLK	599282
13		705-0901	WIRE 22AWG WHT/BRN	599282
14		705-0902	WIRE 22AWG WHT/RED	599282
15		705-0904	WIRE 22AWG WHT/YEL	599282
16		705-0910	WIRE 22AWG WHT	599282
17		3388-0116	CABLE COAX RG174/U	599282
0	P 1	3394-0003	CONN 16PIN MALE	599282
0	P 2	3394-1003	CONN 16PIN FEMALE	599282
			CABL ASSY 24PIN PATCH	599283
1		94-0025	TUBING SHRINKABLE	599283
2		95-0025	TUBING INSULATING	599283
3		705-0010	WIRE 22AWG BLK	599283
4		705-0110	WIRE 22AWG BRN	599283
5		705-0210	WIRE 22AWG RED	599283
6		705-0310	WIRE 22AWG ORN	599283
7		705-0410	WIRE 22AWG YEL	599283
8		705-0510	WIRE 22AWG GRN	599283
9		705-0610	WIRE 22AWG BLUE	599283
10		705-0710	WIRE 22AWG VIO	599283
11		705-0810	WIRE 22AWG GREY	599283
12		705-0900	WIRE 22AWG WHT/BLK	599283
13		705-0901	WIRE 22AWG WHT/BRN	599283
14		705-0902	WIRE 22AWG WHT/RED	599283
15		705-0903	WIRE 22AWG WHT/ORN	599283
16		705-0904	WIRE 22AWG WHT/YEL	599283
17		705-0905	WIRE 22AWG WHT/GRN	599283
18		705-0906	WIRE 22AWG WHT/BLUE	599283
19		705-0907	WIRE 22AWG WHT/VIO	599283
20		705-0908	WIRE 22AWG WHT/GREY	599283
21		705-0910	WIRE 22AWG WHT	599283
22	P 1	3394-0004	CONN 24PIN MALE	599283
23	P 2	3394-1004	CONN 24PIN FEMALE	599283
			ASSY CHASSIS	599378
1		220-0024	SCREW FL HD 6 32X3/8	599378
2		223-0032	SCREW FL HD 10 32X1/2	599378
3		612-0017	HANDLE	599378
4		3326-0044	RIVET POP	599378
5		3326-1043	RIVET POP	599378
6		599016-0001	BAR CHASSIS	599378

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
7		599016-0002	BAR CHASSIS	599378
8		599016-0003	BAR CHASSIS	599378
9		599017-0006	RAIL GUIDE	599378
10		599019-0001	COVER BOTTOM	599378
11		599019-0002	COVER TOP	599378
12		599322-0001	BRACKET END LEFT	599378
13		599368-0001	BRACKET END RIGHT	599378
			ASSY WIRING HARNESS	599380
1		703-0010	WIRE 18AWG BLK	599380
2		703-0110	WIRE 18AWG BRN	599380
3		703-0210	WIRE 18AWG RED	599380
4		703-0310	WIRE 18 AWG ORN	599380
5		703-0410	WIRE 18AWG YEL	599380
6		703-0510	WIRE 18AWG GRN	599380
7		703-0610	WIRE 18AWG BLUE	599380
8		703-0710	WIRE 18AWG VIO	599380
9		703-0810	WIRE 18AWG GREY	599380
10		703-0900	WIRE 18AWG WH/BLK	599380
11		703-0905	WIRE 18AWG WH/GRN	599380
12		703-0908	WIRE 18AWG WH/GRAY	599380
13		703-0910	WIRE 18AWG WH	599380
14		705-0110	WIRE 22AWG BRN	599380
15		705-0210	WIRE 22AWG RED	599380
16		705-0310	WIRE 22AWG ORN	599380
17		705-0410	WIRE 22AWG YEL	599380
18		705-0510	WIRE 22AWG GRN	599380
19		705-0610	WIRE 22AWG BLUE	599380
20		705-0710	WIRE 22AWG VIO	599380
21		705-0810	WIRE 22AWG GREY	599380
22		705-0900	WIRE 22AWG WH/BLK	599380
23		705-0901	WIRE 22AWG WH/BRN	599380
24		705-0903	WIRE 22AWG WH/ORN	599380
25		705-0904	WIRE 22AWG WH/YEL	599380
26		705-0905	WIRE 22AWG WH/GRN	599380
27		705-0906	WIRE 22AWG WH/BLUE	599380
28		705-0907	WIRE 22AWG WH/VIO	599380
29		705-0908	WIRE 22AWG WH/GREY	599380
30		705-0910	WIRE 22AWG WH	599380
31		3388-0116	CABLE COAX RG/174U	599380
35		8819-0022	WIRE 22AWG BUSS	599380
33	J 1	3394-1003	CONN BLUE RIBBON 16S	599380
33	J 2	3394-1003	CONN BLUE RIBBON 16S	599380
34	J 3	3394-1004	CONN BLUE RIBBON 24S	599380
34	J 4	3394-1004	CONN BLUE RIBBON 24S	599380
34	J 5	3394-1004	CONN BLUE RIBBON 24S	599380
32	J 16	3392-1006	CONN BLUE RIBBON 16S	599380
			ASSY WIRING HARNESS	599384
1		705-0010	WIRE 22 AWG BLK	599384
2		706-0010	WIRE 26 AWG BLK	599384
3		706-0110	WIRE 26 AWG BRN	599384
4		706-0210	WIRE 26 AWG RED	599384
4		706-0903	WIRE 26 AWG WH/ORN	599384
5		706-0310	WIRE 26 AWG ORN	599384
6		706-0410	WIRE 26 AWG YEL	599384
7		706-0510	WIRE 26 AWG GRN	599384
8		706-0610	WIRE 26 AWG BLUE	599384
9		706-0710	WIRE 26 AWG VIO	599384
10		706-0810	WIRE 26 AWG GRAY	599384
11		706-0900	WIRE 26 AWG WH/BLK	599384
12		706-0901	WIRE 26 AWG WH/BRN	599384
13		706-0902	WIRE 26 AWG WH/RED	599384
15		706-0904	WIRE 26 AWG WH/YEL	599384
16		706-0905	WIRE 26 AWG WH/GRN	599384
17		706-0906	WIRE 26 AWG WH/BLUE	599384
18		706-0907	WIRE 26 AWG WH/VIO	599384
19		706-0908	WIRE 26 AWG WH/GRAY	599384
21		3389-0011	CORD LACING	599384
23		3486-0001	LUG SOLDER NO4	599384
24	C 1	8914-0101	CAP 100 MFD 20V	599384
20	J 1	3318-5016	CONN 22 PIN	599384
20	J 2	3318-5016	CONN 22 PIN	599384
22	P 1	3394-0004	CONN 24 PIN	599384
			ASSY PHASE SERVO	599394
1		175-0016	SCR BIND HD 4 40X1/4	599394
2		175-0020	SCR BIND HD 4 40X5/16	599394
4		175-0032	SCR BIND HD 4 40X1/2	599394

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
5		177-0016	SCR BIND HD 6 32X1/4	599394
6		177-0020	SCR BIND HD 6 32X5/16	599394
10		242-0020	SCR FIL HD 6 32X5//6	599394
11		365-0024	SCR HEX HD 4 40X3/8	599394
12		399-0016	SCR HEX SOC 4 40X1/4	599394
13		561-0024	SCR HEX SOC 6 32X3/8	599394
14		611-0053	FERRULE	599394
15		612-0003	HANDLE	599394
17		617-0267	WASHER FLAT NO 6	599394
18		620-0123	WASHER IT LOCK NO 4	599394
19		620-0125	WASHER IT LOCK NO 6	599394
20		639-0006	WASHER NYLON NO 4	599394
21		647-0010	NUT SERRATED 15/32 32	599394
22		649-0074	NUT 4 40	599394
23		649-0114	NUT 6 32	599394
24		653-0019	WASHER FLAT 15/32	599394
25		3326-0032	RIVET POP N	599394
26		3326-0042	RIVET POP	599394
27		3326-0045	RIVET POP	599394
28		3326-0046	RIVET POP	599394
29		3326-0132	RIVET POP	599394
30		3331-0037	NUT CLINCH 6 32	599394
31		3455-0772	CLAMP CABLE	599394
32		3458-0094	KNOB POINTER	599394
33		3475-0001	SCREW CAPTIVE 6 32	599394
36		6152	PLATE IDENTIFICATION	599394
37		21472-0003	INK MARKING	599394
38		599213	SUPPORT CHASSIS	599394
39		599246	BRACKET	599394
40		599247	CHASSIS MOD BOTTOM	599394
41		599248	BAR CORNER	599394
42		599249	GUIDE PCB	599394
43		599250	COVER ACCESS	599394
46		599255	BRKT PANEL SPACER	599394
47		599256	SPACER FRONT	599394
48		599257	COVER	599394
49		599273-0735	SPACER REAR	599394
50		599359	PANEL FRONT	599394
51		599363	PANEL REAR RED	599394
58		3807-0001	RUBBER STRIP	599394
54	A 2	599569	ASSY PCB LO LIM/FILT	599394
55	A 3	599570	ASSY PCB PHASE SHIFT	599394
52	A 4	599384	ASSY WIRING HARNESS	599394
53	M 1	599403	COUNTER	599394
7	R 1	205-2372	RES FXD FILM 23X7 K	599394
9	R 2	205-8252	RES FXD FILM 82X5 K	599394
8	R 3	205-3163	RES FXD FILM 316K	599394
34	S 1	3639-2002	SWITCH	599394
35	S 2	3642-0016	SWITCH	599394
			INDUCTOR ASSY	599534
1		175-0020	SCR BND HD 4 40 5/16	599534
2		651-0005	NUT HEX	599534
3		3426-0013	TUBING TEFLON	599534
4		3463-0001	TRIMMER	599534
5		3464-0001	CUP CORE PAIR	599534
6		3465-0002	BOBBIN	599534
7		3466-0001	BKT ASSY	599534
8		3501-0034	WIRE	599534
9		3570-0008	TAPE ELECTRICAL	599534
10		3616-0001	SHIELD AS REQD	599534
11		599535	COIL ASSY	599534
			ASSY PCB AUDIO AMPL	599552
1		82	INSULATOR TSTR	599552
20		3571-0753	STRAP RUBBER	599552
23		3646	SHIELD TRANSFORMER	599552
28		21472-0003	INK MARKING	599552
32		599550	BOARD PRINTED CIRCUIT	599552
29	C 1	27512-0181	CAP 180 PFD 500 V	599552
30	C 2	27512-0331	CAP 330 PFD 500 V	599552
30	C 3	27512-0331	CAP 330 PFD 500 V	599552
29	C 4	27512-0181	CAP 180 PFD 500 V	599552
25	C 5	3655-5001	CAP X005 MFD 100 V	599552
31	C 6	27512-0471	CAP 470 PFD 500 V	599552
18	C 7	3324-9334	CAP X0033 MFD 200 V	599552
26	C 8	8916-9331	CAP 3X3 MFD 15 V	599552
17	C 9	3324-9102	CAP X1 MFD 200 V	599552
27	C 10	8918-9681	CAP 6X8 MFD 6 V	599552
19	L 1	3423-9601	INDUCTOR 6 H	599552
15	Q 1	900-2270	TSTR NPN 2N2270	599552

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
15	Q 2	900-2270	TSTR NPN 2N2270	599552
15	Q 3	900-2270	TSTR NPN 2N2270	599552
15	Q 4	900-2270	TSTR NPN 2N2270	599552
16	Q 5	902-1671	TSTR UNIJCN 2N1671B	599552
15	Q 6	900-2270	TSTR NPN 2N2270	599552
15	Q 7	900-2270	TSTR NPN 2N2270	599552
15	Q 8	900-2270	TSTR NPN 2N2270	599552
11	R 1	200-0682	RES FXD COMP 6X8 K	599552
8	R 2	200-0223	RES FXD COMP 22 K	599552
8	R 3	200-0223	RES FXD COMP 22 K	599552
8	R 4	200-0223	RES FXD COMP 22 K	599552
4	R 5	200-0105	RES FXD COMP 1 M	599552
9	R 6	200-0272	RES FXD COMP 2X7 K	599552
10	R 7	200-0393	RES FXD COMP 39 K	599552
10	R 8	200-0393	RES FXD COMP 39 K	599552
11	R 9	200-0682	RES FXD COMP 6X8 K	599552
9	R 10	200-0272	RES FXD COMP 2X7 K	599552
4	R 11	200-0105	RES FXD COMP 1 M	599552
8	R 12	200-0223	RES FXD COMP 22 K	599552
24	R 13	3652-0203	RES VAR 20 K	599552
13	R 14	211-5622	RES FXD FILM 56X2 K	599552
12	R 15	211-2150	RES FXD FILM215 OHM	599552
5	R 16	200-0153	RES FXD COMP 15 K	599552
7	R 17	200-0183	RES FXD COMP 18 K	599552
3	R 18	200-0103	RES FXD COMP 10 K	599552
6	R 19	200-0181	RES FXD COMP 180 OHM	599552
6	R 20	200-0181	RES FXD COMP 180 OHM	599552
2	R 21	200-0102	RES FXD COMP 1 K	599552
2	R 22	200-0102	RES FXD COMP 1 K	599552
22	T 1	3645-0036	TRANSFORMER 10K 10K	599552
21	T 2	3645-0034	TRANSFORMER 1X6 K 3X2	599552
14	CR 1	800-0662	DIODE IN662	599552
14	CR 2	800-0662	DIODE IN662	599552
			ASSY PCB RECEIVER	599568
1		82	INSULATOR TSTR	599568
30		3388-0092	INCHES CABLE COAXIAL	599568
34		3657-0001	INSULATOR TSTR	599568
38		21472-0003	INK MARKING AS REQD	599568
43		599204	BOARD PRINTED CIRCUIT	599568
39	C 1	21485-9101	CAP 1 MFD 35 V	599568
36	C 2	8917-0121	CAP 120 MFD 10 V	599568
36	C 4	8917-0121	CAP 120 MFD 10 V	599568
29	C 5	3340-9101	CAP 1 MFD 25 V	599568
36	C 6	8917-0121	CAP 120 MFD 10 V	599568
36	C 7	8917-0121	CAP 120 MFD 10 V	599568
32	C 9	3404-9472	CAP X47 MFD 3 V	599568
36	C 10	8917-0121	CAP 120 MFD 10 V	599568
31	C 11	3403-9103	CAP X01 MFD 50 V	599568
32	C 12	3404-9472	CAP X47 MFD 3 V	599568
40	C 13	21485-9332	CAP X33 MFD 35 V	599568
35	C 14	8914-0150	CAP 15 MFD 20 V	599568
32	C 15	3404-9472	CAP X47 MFD 3 V	599568
31	C 18	3403-9103	CAP X01 MFD 50 V	599568
33	C 19	3611-9473	CAP X047 MFD 200 V	599568
39	C 20	21485-9101	CAP 1 MFD 35 V	599568
37	C 21	8917-0390	CAP 39 MFD 10 V	599568
36	C 22	8917-0121	CAP 120 MFD 10 V	599568
36	C 23	8917-0121	CAP 120 MFD 10 V	599568
28	C 24	3340-0100	CAP 10 MFD 25 V	599568
29	C 26	3340-9101	CAP 1 MFD 25 V	599568
28	C 27	3340-0100	CAP 10 MFD 25 V	599568
29	C 28	3340-9101	CAP 1 MFD 25 V	599568
26	C 29	3324-9103	CAP X01 MFD 200V	599568
27	C 30	3324-9224	CAP X0022 MFD 200 V	599568
41	C 31	27512-0821	CAP FXD MICA 820 PFD	599568
48	L 1	599562	INDUCTOR 100 MH	599568
45	L 2	599318	INDUCTOR X5 H	599568
47	L 3	599534	INDUCTOR 3X3 MH	599568
25	P 1	3318-0028	CONN 22P	599568
22	Q 1	900-1305	TSTR PNP 2N1305	599568
22	Q 2	900-1305	TSTR PNP 2N1305	599568
22	Q 3	900-1305	TSTR PNP 2N1305	599568
23	Q 4	900-1995	TSTR NPN 2N1995	599568
21	Q 5	900-1304	TSTR NPN 2N1304	599568
21	Q 6	900-1304	TSTR NPN 2N1304	599568
22	Q 7	900-1305	TSTR PNP 2N1305	599568
22	Q 8	900-1305	TSTR PNP 2N1305	599568
21	Q 9	900-1304	TSTR NPN 2N1304	599568
22	Q 10	900-1305	TSTR PNP 2N1305	599568
22	Q 11	900-1305	TSTR PNP 2N1305	599568
24	Q 14	900-2280	TSTR PNP 2N2280	599568
21	Q 15	900-1304	TSTR NPN 2N1304	599568

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
21	Q 16	900-1304	TSTR NPN 2N1304	599568
21	Q 17	900-1304	TSTR NPN 2N1304	599568
21	Q 18	900-1304	TSTR NPN 2N1304	599568
21	Q 19	900-1304	TSTR NPN 2N1304	599568
21	Q 20	900-1304	TSTR NPN 2N1304	599568
21	Q 21	900-1304	TSTR NPN 2N1304	599568
18	R 1	200-0683	RES FXD COMP 68 K	599568
20	R 2	204-0511	RES FXD COMP 510 OHM	599568
6	R 3	200-0124	RES FXD COMP 120 K	599568
4	R 4	200-0103	RES FXD COMP 10 K	599568
2	R 5	200-0101	RES FXD COMP 100 OHM	599568
17	R 6	200-0562	RES FXD COMP 5X6 K	599568
9	R 7	200-0222	RES FXD COMP 2X2 K	599568
15	R 8	200-0472	RES FXD COMP 4X7 K	599568
15	R 9	200-0472	RES FXD COMP 4X7 K	599568
12	R 10	200-0273	RES FXD COMP 27 KK	599568
2	R 11	200-0101	RES FXD COMP 100 OHM	599568
2	R 12	200-0101	RES FXD COMP 100 OHM	599568
4	R 14	200-0103	RES FXD COMP 10 K	599568
8	R 16	200-0220	RES FXD COMP 22 OHM	599568
10	R 17	200-0223	RES FXD COMP 22 K	599568
17	R 18	200-0562	RES FXD COMP 5X6 K	599568
5	R 19	200-0122	RES FXD COMP 1X2 K	599568
17	R 20	200-0562	RES FXD COMP 5X6 K	599568
14	R 21	200-0333	RES FXD COMP 33K	599568
7	R 22	200-0153	RES FXD COMP 15 K	599568
10	R 23	200-0223	RES FXD COMP 22 K	599568
15	R 24	200-0472	RES FXD COMP 4X7 K	599568
5	R 27	200-0122	RES FXD COMP 1X2 K	599568
19	R 28	200-0823	RES FXD COMP 82 K	599568
13	R 29	200-0331	RES FXD COMP 330 OHM	599568
18	R 30	200-0683	RES FXD COMP 68 K	599568
3	R 31	200-0102	RES FXD COMP 1 K	599568
14	R 32	200-0333	RES FXD COMP 33 K	599568
11	R 33	200-0272	RES FXD COMP 2X7 K	599568
6	R 34	200-0124	RES FXD COMP 120 K	599568
18	R 35	200-0683	RES FXD COMP 68 K	599568
4	R 36	200-0103	RES FXD COMP 10 K	599568
2	R 37	200-0101	RES FXD COMP 100 OHM	599568
9	R 38	200-0222	RES FXD COMP 2X2 K	599568
9	R 39	200-0222	RES FXD COMP 2X2 K	599568
3	R 40	200-0102	RES FXD COMP 1 K	599568
9	R 42	200-0222	RES FXD COMP 2X2 K	599568
9	R 43	200-0222	RES FXD COMP 2X2 K	599568
3	R 44	200-0102	RES FXD COMP 1 K	599568
15	R 46	200-0472	RES FXD COMP 4X7 K	599568
16	R 47	200-0561	RES FXD COMP 560 OHM	599568
46	T 1	599319	TRANSFORMER	599568
44	CR 1	599238	DIODE	599568
			ASSY PCB LO LIM/FILT	599569
1		82	INSULATOR TSTR	599569
61		3326-0046	RIVET POP	599569
62		3326-0132	RIVET POP	599569
73		3657-0001	INSULATOR TSTR	599569
78		21472-0003	INK MARKING AS REQ	599569
84		599354	BOARD PRINTED CIRCUIT	599569
74	C 1	8916-9331	CAP 3X3 MFD 15V	599569
74	C 2	8916-9331	CAP 3X3 MFD 15V	599569
63	C 3	3403-9103	CAP X01 MFD 50V	599569
63	C 4	3403-9103	CAP X01 MFD 50V	599569
79	C 5	27511-0561	CAP 560 PFD 500V	599569
81	C 6	27512-0180	CAP 18 PFD 500V	599569
71	C 7	3632-0011	CAP X8 30 PFD VAR	599569
82	C 8	27512-0181	CAP 180 PFD 500V	599569
58	C 9	3324-9154	CAP 1500 PFD 200V	599569
83	C 10	27512-0271	CAP 270 PFD 500V	599569
72	C 11	3655-1001	CAP X001 MFD 100V	599569
72	C 12	3655-1001	CAP X001 MFD 100V	599569
77	C 13	8918-0560	CAP 56 MFD 6V	599569
75	C 14	8917-0121	CAP 120 MFD 10V	599569
72	C 15	3655-1001	CAP X001 MFD 100V	599569
68	C 16	3612-9102	CAP X1 MFD 200V	599569
60	C 17	3324-9475	CAP 470 PFD 200V	599569
58	C 18	3324-9154	CAP 1500 PFD 200V	599569
76	C 19	8917-0390	CAP 39 MFD 10V	599569
76	C 20	8917-0390	CAP 39 MFD 10V	599569
57	C 21	3319-0471	CAP 470 PFD 1000V	599569
74	C 22	8916-9331	CAP 3X3 MFD 15V	599569
59	C 23	3324-9223	CAP X022 MFD 200V	599569
68	C 24	3612-9102	CAP X1 MFD 200V	599569
68	C 25	3612-9102	CAP X1 MFD 200V	599569
63	C 26	3403-9103	CAP X01 MFD 50V	599569

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
80	C 28	27512-0121	CAP 120 PFD 500V	599569
74	C 30	8916-9331	CAP 3X3 MFD 15V	599569
64	L 1	3568-0150	INDUCTOR 15 UH	599569
64	L 2	3568-0150	INDUCTOR 15 UH	599569
65	L 3	3568-0270	INDUCTOR 27 UH	599569
65	L 4	3568-0270	INDUCTOR 27 UH	599569
65	L 5	3568-0270	INDUCTOR 27 UH	599569
56	P 1	3318-0028	CONN 22 PIN	599569
53	Q 1	900-2270	TSTR NPN 2N2270	599569
53	Q 2	900-2270	TSTR NPN 2N2270	599569
55	Q 3	902-0711	TSTR PNP 2N711B	599569
55	Q 4	902-0711	TSTR PNP 2N711B	599569
53	Q 5	900-2270	TSTR NPN 2N2270	599569
55	Q 6	902-0711	TSTR PNP 2N711B	599569
49	Q 7	900-1305	TSTR PNP 2N71305	599569
52	Q 8	900-2218	TSTR NPN 2N2218	599569
49	Q 9	900-1305	TSTR PNP 2N71305	599569
52	Q 10	900-2218	TSTR NPN 2N2218	599569
53	Q 11	900-2270	TSTR NPN 2N2270	599569
49	Q 12	900-1305	TSTR PNP 2N71305	599569
53	Q 14	900-2270	TSTR NPN 2N2270	599569
55	Q 15	902-0711	TSTR PNP 2N711B	599569
53	Q 16	900-2270	TSTR NPN 2N2270	599569
55	Q 17	902-0711	TSTR PNP 2N711B	599569
51	Q 18	900-2102	TSTR NPN 2N2102	599569
54	Q 19	900-3134	TSTR PNP 2N3134	599569
54	Q 20	900-3134	TSTR PNP 2N3134	599569
51	Q 21	900-2102	TSTR NPN 2N2102	599569
50	Q 22	900-1995	TSTR NPN 2N1995	599569
53	Q 23	900-2270	TSTR NPN 2N2270	599569
53	Q 24	900-2270	TSTR NPN 2N2270	599569
48	Q 25	900-1304	TSTR NPN 2N1304	599569
49	Q 26	900-1305	TSTR PNP 2N71305	599569
53	Q 27	900-2270	TSTR NPN 2N2270	599569
49	Q 28	900-1305	TSTR PNP 2N71305	599569
49	Q 29	900-1305	TSTR PNP 2N71305	599569
53	Q 30	900-2270	TSTR NPN 2N2270	599569
53	Q 31	900-2270	TSTR NPN 2N2270	599569
53	Q 32	900-2270	TSTR NPN 2N2270	599569
53	Q 33	900-2270	TSTR NPN 2N2270	599569
49	Q 34	900-1305	TSTR PNP 2N71305	599569
48	Q 35	900-1304	TSTR NPN 2N1304	599569
48	Q 36	900-1304	TSTR NPN 2N1304	599569
49	Q 37	900-1305	TSTR PNP 2N71305	599569
53	Q 38	900-2270	TSTR NPN 2N2270	599569
49	Q 39	900-1305	TSTR PNP 2N71305	599569
49	Q 40	900-1305	TSTR PNP 2N71305	599569
53	Q 41	900-2270	TSTR NPN 2N2270	599569
53	Q 42	900-2270	TSTR NPN 2N2270	599569
53	Q 43	900-2270	TSTR NPN 2N2270	599569
47	Q 44	900-1038	TSTR PNP 2N1038	599569
48	Q 45	900-1304	TSTR NPN 2N1304	599569
49	Q 46	900-1305	TSTR PNP 2N1305	599569
2	R 1	200-0100	RES FXD COMP 10 OHM	599569
2	R 2	200-0100	RES FXD COMP 10 OHM	599569
4	R 3	200-0102	RES FXD COMP 1 KOHM	599569
17	R 4	200-0331	RES FXD COMP 330 OHM	599569
28	R 5	200-0821	RES FXD COMP 820 OHM	599569
3	R 6	200-0101	RES FXD COMP 100 OHM	599569
20	R 7	200-0470	RES FXD COMP 47 OHM	599569
11	R 8	200-0183	RES FXD COMP 18K	599569
25	R 9	200-0562	RES FXD COMP 5X6K	599569
19	R 10	200-0392	RES FXD COMP 3X9K	599569
7	R 11	200-0122	RES FXD COMP 1X2K	599569
15	R 12	200-0271	RES FXD COMP 270 OHM	599569
22	R 13	200-0472	RES FXD COMP 4X7K	599569
7	R 14	200-0122	RES FXD COMP 1X2K	599569
31	R 15	205-1211	RES FXD FILM 1X21K	599569
34	R 16	205-2370	RES FXD FILM 237 OHM	599569
18	R 17	200-0391	RES FXD COMP 390 OHM	599569
41	R 18	205-9090	RES FXD FILM 909 OHM	599569
34	R 19	205-2370	RES FXD FILM 237 OHM	599569
38	R 20	205-7321	RES FXD FILM 7X32K	599569
18	R 21	200-0391	RES FXD COMP 390 OHM	599569
12	R 22	200-0221	RES FXD COMP 220 OHM	599569
32	R 23	205-1542	RES FXD FILM 15X4K	599569
20	R 24	200-0470	RES FXD COMP 47 OHM	599569
35	R 25	205-3830	RES FXD FILM 383 OHM	599569
66	R 26	3596-0101	RES VAR 100 OHM	599569
35	R 27	205-3830	RES FXD FILM 383 OHM	599569
12	R 28	200-0221	RES FXD COMP 220 OHM	599569
3	R 30	200-0101	RES FXD COMP 100 OHM	599569
21	R 31	200-0471	RES FXD COMP 470 OHM	599569
13	R 32	200-0222	RES FXD COMP 2X2K	599569
33	R 33	205-2151	RES FXD FILM 2X15K	599569

ITEM NUMBER	REFERENCE DESIGNATION	T R A C O R STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
13	R 34	200-0222	RES FXD COMP 2X2K	599569
9	R 35	200-0152	RES FXD COMP 1X5K	599569
21	R 36	200-0471	RES FXD COMP 470 OHM	599569
31	R 37	205-1211	RES FXD FILM 1X21 K	599569
39	R 38	205-7501	RES FXD FILM 7X50K	599569
39	R 39	205-7501	RES FXD FILM 7X50K	599569
42	R 40	211-1212	RES FXD FILM 12X1K	599569
6	R 41	200-0104	RES FXD COMP 100K	599569
6	R 42	200-0104	RES FXD COMP 100K	599569
30	R 43	205-1102	RES FXD FILM 11X0K	599569
33	R 44	205-2151	RES FXD FILM 2X15K	599569
30	R 47	205-1102	RES FXD FILM 11X0K	599569
3	R 48	200-0101	RES FXD COMP 100 OHM	599569
24	R 49	200-0561	RES FXD COMP 560 OHM	599569
24	R 50	200-0561	RES FXD COMP 560 OHM	599569
24	R 51	200-0561	RES FXD COMP 560 OHM	599569
14	R 52	200-0223	RES FXD COMP 22K	599569
16	R 53	200-0273	RES FXD COMP 27K	599569
4	R 54	200-0102	RES FXD COMP 1 KOHM	599569
4	R 55	200-0102	RES FXD COMP 1 KOHM	599569
29	R 56	205-1002	RES FXD FILM 10X0K	599569
25	R 57	200-0562	RES FXD COMP 5X6K	599569
25	R 58	200-0562	RES FXD COMP 5X6K	599569
3	R 59	200-0101	RES FXD COMP 100 OHM	599569
40	R 60	205-8251	RES FXD FILM 8X25K	599569
36	R 61	205-5111	RES FXD FILM 5X11K	599569
40	R 62	205-8251	RES FXD FILM 8X25K	599569
29	R 63	205-1002	RES FXD FILM 10X0K	599569
23	R 64	200-0560	RES FXD COMP 56 OHM	599569
18	R 65	200-0391	RES FXD COMP 390 OHM	599569
7	R 66	200-0122	RES FXD COMP 1X2K	599569
30	R 67	205-1102	RES FXD FILM 11X0K	599569
40	R 68	205-8251	RES FXD FILM 8X25K	599569
37	R 69	205-6811	RES FXD FILM 6X81K	599569
12	R 70	200-0221	RES FXD COMP 220 OHM	599569
19	R 71	200-0392	RES FXD COMP 3X9K	599569
4	R 72	200-0102	RES FXD COMP 1 KOHM	599569
28	R 73	200-0821	RES FXD COMP 820 OHM	599569
6	R 74	200-0104	RES FXD COMP 100K	599569
5	R 76	200-0103	RES FXD COMP 10KO	599569
27	R 77	200-0682	RES FXD COMP 6X8K	599569
25	R 78	200-0562	RES FXD COMP 5X6K	599569
26	R 79	200-0563	RES FXD COMP 56K	599569
23	R 81	200-0560	RES FXD COMP 56 OHM	599569
9	R 82	200-0152	RES FXD COMP 1X5K	599569
24	R 83	200-0561	RES FXD COMP 560 OHM	599569
23	R 84	200-0560	RES FXD COMP 56 OHM	599569
30	R 85	205-1102	RES FXD FILM 11X0K	599569
5	R 86	200-0103	RES FXD COMP 10K	599569
5	R 87	200-0103	RES FXD COMP 10K	599569
24	R 88	200-0561	RES FXD COMP 560 OHM	599569
5	R 89	200-0103	RES FXD COMP 10K	599569
22	R 90	200-0472	RES FXD COMP 4X7K	599569
22	R 91	200-0472	RES FXD COMP 4X7K	599569
7	R 92	200-0122	RES FXD COMP 1X2K	599569
7	R 93	200-0122	RES FXD COMP 1X2K	599569
4	R 94	200-0102	RES FXD COMP 1 KOHM	599569
4	R 95	200-0102	RES FXD COMP 1 KOHM	599569
8	R 96	200-0151	RES FXD COMP 150 OHM	599569
8	R 97	200-0151	RES FXD COMP 150 OHM	599569
4	R 98	200-0102	RES FXD COMP 1 KOHM	599569
27	R 99	200-0682	RES FXD COMP 6X8K	599569
12	R 100	200-0221	RES FXD COMP 220 OHM	599569
2	R 101	200-0100	RES FXD COMP 10 OHM	599569
10	R 102	200-0181	RES FXD COMP 180 OHM	599569
67	R 103	3596-0502	RES VAR 5K	599569
2	R 104	200-0100	RES FXD COMP 10 OHM	599569
12	R 105	200-0221	RES FXD COMP 220 OHM	599569
17	R 106	200-0331	RES FXD COMP 330 OHM	599569
23	R 107	200-0560	RES FXD COMP 56 OHM	599569
69	Y 1	3630-0001	CRYSTAL	599569
44	CR 1	801-0096	DIODE IN96A	599569
44	CR 2	801-0096	DIODE IN96A	599569
44	CR 3	801-0096	DIODE IN96A	599569
43	CR 4	800-0914	DIODE IN914	599569
43	CR 5	800-0914	DIODE IN914	599569
45	CR 6	801-0456	DIODE IN456A	599569
45	CR 7	801-0456	DIODE IN456A	599569
46	VR 1	801-0752	DIODE IN752A	599569
46	VR 2	801-0752	DIODE IN752A	599569
46	VR 5	801-0752	DIODE IN752A	599569
70	XY 1	3631-0001	HOLDER CRYSTAL	599569

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
			ASSY PCB PH SHIFTER	599570
1		82	INSULATOR TSTR	599570
2		95-0003	TUBING CLEAR AS REQ	599570
53		3326-0046	RIVET POP	599570
54		3326-0132	RIVET POP	599570
67		3657-0001	INSULATOR TSTR	599570
68		8819-0022	WIRE BUSS 22AWG AS RQ	599570
73		21472-0003	INK MARKING AS REQ	599570
84		599360	BOARD PRINTED CIRCUIT	599570
70	C 1	8916-9331	CAP 3X3 MFD 15V	599570
75	C 2	27512-0151	CAP 150 PFD	599570
64	C 3	3632-0011	CAP X8 30 PFD	599570
76	C 4	27512-0180	CAP 18 PFD 500V	599570
77	C 5	27512-0181	CAP 180 PFD 500V	599570
70	C 6	8916-9331	CAP 3X3 MFD 15V	599570
81	C 7	27512-0680	CAP 68 PFD 500V	599570
79	C 8	27512-0221	CAP 220 PFD 500V	599570
70	C 9	8916-9331	CAP 3X3 MFD 15V	599570
82	C 10	27512-0820	CAP 82 PFD 500VV	599570
80	C 11	27512-0271	CAP 270 PFD 500V	599570
74	C 12	27511-0561	CAP 560 PFD 500V	599570
66	C 13	3655-1001	CAP X001 MFD 100V	599570
66	C 14	3655-1001	CAP X001 MFD 100V	599570
66	C 15	3655-1001	CAP X001 MFD 100V	599570
72	C 16	8918-0560	CAP 56 MFD 6V	599570
66	C 17	3655-1001	CAP X001 MFD 100V	599570
66	C 18	3655-1001	CAP X001 MFD 100V	599570
80	C 19	27512-0271	CAP 270 PFD 500V	599570
69	C 20	8914-0150	CAP 15 MFD 20V	599570
80	C 21	27512-0271	CAP 270 PFD 500V	599570
80	C 22	27512-0271	CAP 270 PFD 500V	599570
80	C 23	27512-0271	CAP 270 PFD 500V	599570
80	C 24	27512-0271	CAP 270 PFD 500V	599570
55	C 25	3403-9103	CAP X01 MFD 50V	599570
55	C 26	3403-9103	CAP X01 MFD 50V	599570
52	C 27	3324-9102	CAP X1 MFD 200V	599570
70	C 28	8916-9331	CAP 3X3 MFD 15V	599570
83	C 29	27513-0471	CAP 470 PFD 500V	599570
80	C 30	27512-0271	CAP 270 PFD 500V	599570
78	C 31	27512-0220	CAP 22 PFD 500VV	599570
78	C 32	27512-0220	CAP 22 PFD 500VV	599570
83	C 33	27513-0471	CAP 470 PFD 500V	599570
70	C 34	8916-9331	CAP 3X3 MFD 15V	599570
80	C 35	27512-0271	CAP 270 PFD 500V	599570
78	C 36	27512-0220	CAP 22 PFD 500VV	599570
78	C 37	27512-0220	CAP 22 PFD 500VV	599570
80	C 38	27512-0271	CAP 270 PFD 500V	599570
78	C 39	27512-0220	CAP 22 PFD 500VV	599570
83	C 40	27513-0471	CAP 470 PFD 500V	599570
83	C 41	27513-0471	CAP 470 PFD 500V	599570
70	C 42	8916-9331	CAP 3X3 MFD 15V	599570
71	C 43	8917-0121	CAP 120 MFD 10V	599570
70	C 44	8916-9331	CAP 3X3 MFD 15V	599570
70	C 45	8916-9331	CAP 3X3 MFD 15V	599570
70	C 46	8916-9331	CAP 3X3 MFD 15V	599570
70	C 47	8916-9331	CAP 3X3 MFD 15V	599570
71	C 48	8917-0121	CAP 120 MFD 10V	599570
71	C 49	8917-0121	CAP 120 MFD 10V	599570
65	L 1	3653-9151	INDUCTOR 1X5 UH VAR	599570
59	L 2	3568-9391	INDUCTOR 3X9 UH	599570
60	L 3	3568-9471	INDUCTOR 4X7 UH	599570
56	L 4	3568-0100	INDUCTOR 10 UH	599570
58	L 5	3568-0270	INDUCTOR 27 UH	599570
58	L 6	3568-0270	INDUCTOR 27 UH	599570
58	L 7	3568-0270	INDUCTOR 27 UH	599570
58	L 8	3568-0270	INDUCTOR 27 UH	599570
58	L 9	3568-0270	INDUCTOR 27 UH	599570
58	L 10	3568-0270	INDUCTOR 27 UH	599570
57	L 11	3568-0101	INDUCTOR 100 UH	599570
57	L 12	3568-0101	INDUCTOR 100 UH	599570
51	P 1	3318-0028	CONN 22 PIN	599570
49	Q 1	900-3134	TSTR PNP 2N3134	599570
49	Q 2	900-3134	TSTR PNP 2N3134	599570
50	Q 3	902-0711	TSTR PNP 2N711B	599570
48	Q 4	900-2218	TSTR NPN 2N2218	599570
50	Q 5	902-0711	TSTR PNP 2N711B	599570
50	Q 6	902-0711	TSTR PNP 2N711B	599570
48	Q 7	900-2218	TSTR NPN 2N2218	599570
50	Q 8	902-0711	TSTR PNP 2N711B	599570
48	Q 9	900-2218	TSTR NPN 2N2218	599570
47	Q 10	900-1305	TSTR PNP 2N1305	599570
48	Q 11	900-2218	TSTR NPN 2N2218	599570
47	Q 12	900-1305	TSTR PNP 2N1305	599570
48	Q 13	900-2218	TSTR NPN 2N2218	599570

ITEM NUMBER	REFERENCE DESIGNATION	T R A C O R STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
47	Q 14	900-1305	TSTR PNP 2N1305	599570
48	Q 15	900-2218	TSTR NPN 2N2218	599570
47	Q 16	900-1305	TSTR PNP 2N1305	599570
48	Q 17	900-2218	TSTR NPN 2N2218	599570
47	Q 18	900-1305	TSTR PNP 2N1305	599570
48	Q 19	900-2218	TSTR NPN 2N2218	599570
47	Q 20	900-1305	TSTR PNP 2N1305	599570
48	Q 21	900-2218	TSTR NPN 2N2218	599570
50	Q 22	902-0711	TSTR PNP 2N711B	599570
47	Q 23	900-1305	TSTR PNP 2N1305	599570
47	Q 24	900-1305	TSTR PNP 2N1305	599570
47	Q 25	900-1305	TSTR PNP 2N1305	599570
47	Q 26	900-1305	TSTR PNP 2N1305	599570
47	Q 27	900-1305	TSTR PNP 2N1305	599570
48	Q 28	900-2218	TSTR NPN 2N2218	599570
46	Q 29	900-0708	TSTR NPN 2N708	599570
46	Q 30	900-0708	TSTR NPN 2N708	599570
48	Q 31	900-2218	TSTR NPN 2N2218	599570
46	Q 32	900-0708	TSTR NPN 2N708	599570
46	Q 33	900-0708	TSTR NPN 2N708	599570
46	Q 34	900-0708	TSTR NPN 2N708	599570
46	Q 35	900-0708	TSTR NPN 2N708	599570
48	Q 36	900-2218	TSTR NPN 2N2218	599570
48	Q 37	900-2218	TSTR NPN 2N2218	599570
11	R 1	200-0222	RES FXD COMP 2X2K	599570
13	R 2	200-0271	RES FXD COMP 270 OHM	599570
24	R 3	200-0560	RES FXD COMP 56 OHM	599570
22	R 4	200-0471	RES FXD COMP 470 OHM	599570
27	R 5	200-0681	RES FXD COMP 680 OHM	599570
11	R 6	200-0222	RES FXD COMP 2X2K	599570
3	R 7	200-0100	RES FXD COMP 10 OHM	599570
25	R 8	200-0561	RES FXD COMP 560 OHM	599570
4	R 9	200-0101	RES FXD COMP 100 OHM	599570
17	R 10	200-0331	RES FXD COMP 330 OHM	599570
25	R 11	200-0561	RES FXD COMP 560 OHM	599570
34	R 12	205-8250	RES FXD FILM 825 OHM	599570
32	R 13	205-2370	RES FXD FILM 237 OHM	599570
35	R 14	205-9090	RES FXD FILM 909 OHM	599570
32	R 15	205-2370	RES FXD FILM 237 OHM	599570
13	R 16	200-0271	RES FXD COMP 270 OHM	599570
35	R 17	205-9090	RES FXD FILM 909 OHM	599570
19	R 18	200-0391	RES FXD COMP 390 OHM	599570
37	R 19	211-3161	RES FXD FILM 3X16K	599570
61	R 20	3596-0202	RES VAR 2K 1/2W	599570
41	R 21	211-4221	RES FXD FILM 4X22K	599570
32	R 22	205-2370	RES FXD FILM 237 OHM	599570
19	R 23	200-0391	RES FXD COMP 390 OHM	599570
35	R 24	205-9090	RES FXD FILM 909 OHM	599570
29	R 25	205-1402	RES FXD FILM 14X0K	599570
32	R 26	205-2370	RES FXD FILM 237 OHM	599570
35	R 27	205-9090	RES FXD FILM 909 OHM	599570
19	R 28	200-0391	RES FXD COMP 390 OHM	599570
30	R 29	205-1622	RES FXD FILM 16X2K	599570
22	R 30	200-0471	RES FXD COMP 470 OHM	599570
32	R 31	205-2370	RES FXD FILM 237 OHM	599570
35	R 32	205-9090	RES FXD FILM 909 OHM	599570
33	R 33	205-8062	RES FXD FILM 80X6K	599570
32	R 34	205-2370	RES FXD FILM 237 OHM	599570
19	R 35	200-0391	RES FXD COMP 390 OHM	599570
31	R 36	205-1743	RES FXD FILM 174K	599570
19	R 37	200-0391	RES FXD COMP 390 OHM	599570
26	R 38	200-0564	RES FXD COMP 560K	599570
10	R 39	200-0221	RES FXD COMP 220 OHM	599570
3	R 40	200-0100	RES FXD COMP 10 OHM	599570
34	R 41	205-8250	RES FXD FILM 825 OHM	599570
32	R 42	205-2370	RES FXD FILM 237 OHM	599570
10	R 43	200-0221	RES FXD COMP 220 OHM	599570
19	R 44	200-0391	RES FXD COMP 390 OHM	599570
33	R 45	205-8062	RES FXD FILM 80X6K	599570
35	R 46	205-9090	RES FXD FILM 909 OHM	599570
32	R 47	205-2370	RES FXD FILM 237 OHM	599570
19	R 48	200-0391	RES FXD COMP 390 OHM	599570
31	R 49	205-1743	RES FXD FILM 174K	599570
19	R 50	200-0391	RES FXD COMP 390 OHM	599570
22	R 51	200-0471	RES FXD COMP 470 OHM	599570
9	R 52	200-0151	RES FXD COMP 150 OHM	599570
19	R 53	200-0391	RES FXD COMP 390 OHM	599570
11	R 54	200-0222	RES FXD COMP 2X2K	599570
28	R 55	200-0823	RES FXD COMP 82K	599570
28	R 56	200-0823	RES FXD COMP 82K	599570
15	R 57	200-0273	RES FXD COMP 27K	599570
12	R 58	200-0223	RES FXD COMP 22K	599570
12	R 59	200-0223	RES FXD COMP 22K	599570
5	R 60	200-0102	RES FXD COMP 1X0K	599570
7	R 61	200-0122	RES FXD COMP 1X2K	599570

ITEM NUMBER	REFERENCE DESIGNATION	T R A C O R STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
5	R 62	200-0102	RES FXD COMP 1X0K	599570
15	R 63	200-0273	RES FXD COMP 27K	599570
23	R 64	200-0472	RES FXD COMP 4X7K	599570
11	R 65	200-0222	RES FXD COMP 2X2K	599570
23	R 66	200-0472	RES FXD COMP 4X7K	599570
10	R 67	200-0221	RES FXD COMP 220 OHM	599570
23	R 68	200-0472	RES FXD COMP 4X7K	599570
10	R 69	200-0221	RES FXD COMP 220 OHM	599570
10	R 70	200-0221	RES FXD COMP 220 OHM	599570
8	R 71	200-0123	RES FXD COMP 12K	599570
11	R 72	200-0222	RES FXD COMP 2X2K	599570
36	R 73	211-1001	RES FXD FILM 1X0K	599570
38	R 74	211-3481	RES FXD FILM 3X48K	599570
38	R 75	211-3481	RES FXD FILM 3X48K	599570
36	R 76	211-1001	RES FXD FILM 1X0K	599570
22	R 77	200-0471	RES FXD COMP 470 OHM	599570
19	R 78	200-0391	RES FXD COMP 390 OHM	599570
20	R 79	200-0392	RES FXD COMP 3X9K	599570
18	R 80	200-0332	RES FXD COMP 3X3K	599570
42	R 81	211-7500	RES FXD FILM 750 OHM	599570
38	R 82	211-3481	RES FXD FILM 3X48K	599570
42	R 85	211-7500	RES FXD FILM 750 OHM	599570
39	R 86	211-3482	RES FXD FILM 34X8K	599570
40	R 87	211-3489	RES FXD FILM 34X8 OHM	599570
42	R 88	211-7500	RES FXD FILM 750 OHM	599570
20	R 89	200-0392	RES FXD COMP 3X9K	599570
22	R 90	200-0471	RES FXD COMP 470 OHM	599570
39	R 91	211-3482	RES FXD FILM 34X8K	599570
38	R 92	211-3481	RES FXD FILM 3X48K	599570
38	R 93	211-3481	RES FXD FILM 3X48K	599570
36	R 94	211-1001	RES FXD FILM 1X0K	599570
40	R 95	211-3489	RES FXD FILM 34X8 OHM	599570
18	R 96	200-0332	RES FXD COMP 3X3K	599570
18	R 97	200-0332	RES FXD COMP 3X3K	599570
36	R 98	211-1001	RES FXD FILM 1X0K	599570
6	R 99	200-0103	RES FXD COMP 10K	599570
18	R 100	200-0332	RES FXD COMP 3X3K	599570
42	R 101	211-7500	RES FXD FILM 750 OHM	599570
38	R 102	211-3481	RES FXD FILM 3X48K	599570
26	R 103	200-0564	RES FXD COMP 560K	599570
6	R 104	200-0103	RES FXD COMP 10K	599570
20	R 105	200-0392	RES FXD COMP 3X9K	599570
20	R 106	200-0392	RES FXD COMP 3X9K	599570
38	R 107	211-3481	RES FXD FILM 3X48K	599570
38	R 108	211-3481	RES FXD FILM 3X48K	599570
38	R 109	211-3481	RES FXD FILM 3X48K	599570
38	R 110	211-3481	RES FXD FILM 3X48K	599570
19	R 111	200-0391	RES FXD COMP 390 OHM	599570
19	R 112	200-0391	RES FXD COMP 390 OHM	599570
14	R 113	200-0272	RES FXD COMP 2X7K	599570
16	R 114	200-0330	RES FXD COMP 33 OHM	599570
21	R 115	200-0470	RES FXD COMP 47 OHM	599570
62	Y 1	3630-0002	CRYSTAL	599570
43	CR 1	800-0914	D10DE IN914	599570
43	CR 2	800-0914	D10DE IN914	599570
43	CR 3	800-0914	D10DE IN914	599570
44	CR 4	801-0096	D10DE IN96A4	599570
44	CR 5	801-0096	D10DE IN96A4	599570
43	CR 6	800-0914	D10DE IN914	599570
43	CR 7	800-0914	D10DE IN914	599570
43	CR 8	800-0914	D10DE IN914	599570
43	CR 9	800-0914	D10DE IN914	599570
44	CR 10	801-0096	D10DE IN96A4	599570
44	CR 11	801-0096	D10DE IN96A4	599570
45	VR 1	801-0753	D10DE IN753A	599570
45	VR 2	801-0753	D10DE IN753A	599570
45	VR 3	801-0753	D10DE IN753A	599570
45	VR 4	801-0753	D10DE IN753A	599570
63	XY 1	3631-0001	HOLDER CRYSTAL	599570
			ASSY PCB PRESET CTR	599589
17		3318-0028	CONN 22P	599589
25		3326-0046	RIVET POP	599589
28		21472-0003	INK MARKING	599589
29		599184	BOARD PRINTED CIRCUIT	599589
32		82	INSULATOR TSTR	599589
35		8819-0020	WIRE BUS 20AWG	599589
26	C 1	8917-0121	CAP 120 MFD 10V	599589
18	C 2	3319-0272	CAP 2700 PFD 1000V	599589
33	C 3	3319-0152	CAP 1500 PFD 1000V	599589
21	C 4	3320-9102	CAP X1 MFD 3V	599589
33	C 5	3319-0152	CAP 1500 PFD 1000V	599589
18	C 6	3319-0272	CAP 2700 PFD 1000V	599589

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
33	C 7	3319-0152	CAP 1500 PFD 1000V	599589
21	C 8	3320-9102	CAP X1 MFD 3V	599589
33	C 9	3319-0152	CAP 1500 PFD 1000V	599589
18	C 10	3319-0272	CAP 2700 PFD 1000V	599589
33	C 11	3319-0152	CAP 1500 PFD 1000V	599589
21	C 12	3320-9102	CAP X1 MFD 3V	599589
33	C 13	3319-0152	CAP 1500 PFD 1000V	599589
18	C 14	3319-0272	CAP 2700 PFD 1000V	599589
33	C 15	3319-0152	CAP 1500 PFD 1000V	599589
21	C 16	3320-9102	CAP X1 MFD 3V	599589
33	C 17	3319-0152	CAP 1500 PFD 1000V	599589
19	C 18	3319-0471	CAP 470 PFD 1000V	599589
27	C 19	8917-9471	CAP 4X7 MFD 10V	599589
23	C 20	3323-9224	CAP X0022 MFD 200V	599589
18	C 21	3319-0272	CAP 2700 PFD 1000V	599589
33	C 22	3319-0152	CAP 1500 PFD 1000V	599589
21	C 23	3320-9102	CAP X1 MFD 3V	599589
33	C 24	3319-0152	CAP 1500 PFD 1000V	599589
18	C 25	3319-0272	CAP 2700 PFD 1000V	599589
33	C 26	3319-0152	CAP 1500 PFD 1000V	599589
21	C 27	3320-9102	CAP X1 MFD 3V	599589
33	C 28	3319-0152	CAP 1500 PFD 1000V	599589
18	C 29	3319-0272	CAP 2700 PFD 1000V	599589
33	C 30	3319-0152	CAP 1500 PFD 1000V	599589
21	C 31	3320-9102	CAP X1 MFD 3V	599589
33	C 32	3319-0152	CAP 1500 PFD 1000V	599589
18	C 33	3319-0272	CAP 2700 PFD 1000V	599589
33	C 34	3319-0152	CAP 1500 PFD 1000V	599589
21	C 35	3320-9102	CAP X1 MFD 3V	599589
33	C 36	3319-0152	CAP 1500 PFD 1000V	599589
19	C 37	3319-0471	CAP 470 PFD 1000V	599589
24	C 39	3324-9474	CAP X0047 MFD 200V	599589
33	C 40	3319-0152	CAP 1500 PFD 1000V	599589
21	C 41	3320-9102	CAP X1 MFD 3V	599589
33	C 42	3319-0152	CAP 1500 PFD 1000V	599589
18	C 43	3319-0272	CAP 2700 PFD 1000V	599589
33	C 44	3319-0152	CAP 1500 PFD 1000V	599589
21	C 45	3320-9102	CAP X1 MFD 3V	599589
33	C 46	3319-0152	CAP 1500 PFD 1000V	599589
18	C 47	3319-0272	CAP 2700 PFD 1000V	599589
33	C 48	3319-0152	CAP 1500 PFD 1000V	599589
21	C 49	3320-9102	CAP X1 MFD 3V	599589
33	C 50	3319-0152	CAP 1500 PFD 1000V	599589
19	C 51	3319-0471	CAP 470 PFD 1000V	599589
27	C 52	8917-9471	CAP 4X7 MFD 10V	599589
22	C 53	3324-9153	CAP X015 MFD 200V	599589
20	C 54	3319-0751	CAP 750 PFD 1000V	599589
18	C 55	3319-0272	CAP 2700 PFD 1000V	599589
16	Q 1	900-1304	TSTR NPN 2N1304	599589
16	Q 2	900-1304	TSTR NPN 2N1304	599589
16	Q 3	900-1304	TSTR NPN 2N1304	599589
16	Q 4	900-1304	TSTR NPN 2N1304	599589
16	Q 5	900-1304	TSTR NPN 2N1304	599589
16	Q 6	900-1304	TSTR NPN 2N1304	599589
16	Q 7	900-1304	TSTR NPN 2N1304	599589
16	Q 8	900-1304	TSTR NPN 2N1304	599589
16	Q 9	900-1304	TSTR NPN 2N1304	599589
16	Q 10	900-1304	TSTR NPN 2N1304	599589
16	Q 11	900-1304	TSTR NPN 2N1304	599589
16	Q 12	900-1304	TSTR NPN 2N1304	599589
16	Q 13	900-1304	TSTR NPN 2N1304	599589
16	Q 14	900-1304	TSTR NPN 2N1304	599589
16	Q 15	900-1304	TSTR NPN 2N1304	599589
16	Q 16	900-1304	TSTR NPN 2N1304	599589
16	Q 17	900-1304	TSTR NPN 2N1304	599589
16	Q 18	900-1304	TSTR NPN 2N1304	599589
16	Q 19	900-1304	TSTR NPN 2N1304	599589
16	Q 20	900-1304	TSTR NPN 2N1304	599589
16	Q 21	900-1304	TSTR NPN 2N1304	599589
16	Q 22	900-1304	TSTR NPN 2N1304	599589
16	Q 23	900-1304	TSTR NPN 2N1304	599589
16	Q 24	900-1304	TSTR NPN 2N1304	599589
16	Q 25	900-1304	TSTR NPN 2N1304	599589
16	Q 26	900-1304	TSTR NPN 2N1304	599589
16	Q 27	900-1304	TSTR NPN 2N1304	599589
16	Q 28	900-1304	TSTR NPN 2N1304	599589
16	Q 29	900-1304	TSTR NPN 2N1304	599589
16	Q 30	900-1304	TSTR NPN 2N1304	599589
1	R 1	200-0100	RES FXD COMP 10 OHM	599589
3	R 2	200-0102	RES FXD COMP 1 K	599589
14	R 3	200-0822	RES FXD COMP 8X2 K	599589
9	R 4	200-0332	RES FXD COMP 3X3 K	599589
13	R 5	200-0821	RES FXD COMP 820 OHM	599589
2	R 6	200-0101	RES FXD COMP 100 OHM	599589
3	R 7	200-0102	RES FXD COMP 1 K	599589

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
14	R 8	200-0822	RES FXD COMP 8X2 K	599589
10	R 9	200-0392	RES FXD COMP 3X9 K	599589
3	R 10	200-0102	RES FXD COMP 1 K	599589
14	R 11	200-0822	RES FXD COMP 8X2 K	599589
9	R 12	200-0332	RES FXD COMP 3X3 K	599589
13	R 13	200-0821	RES FXD COMP 820 OHM	599589
2	R 14	200-0101	RES FXD COMP 100 OHM	599589
3	R 15	200-0102	RES FXD COMP 1 K	599589
14	R 16	200-0822	RES FXD COMP 8X2 K	599589
10	R 17	200-0392	RES FXD COMP 3X9 K	599589
3	R 18	200-0102	RES FXD COMP 1 K	599589
14	R 19	200-0822	RES FXD COMP 8X2 K	599589
9	R 20	200-0332	RES FXD COMP 3X3 K	599589
13	R 21	200-0821	RES FXD COMP 820 OHM	599589
2	R 22	200-0101	RES FXD COMP 100 OHM	599589
3	R 23	200-0102	RES FXD COMP 1 K	599589
14	R 24	200-0822	RES FXD COMP 8X2 K	599589
10	R 25	200-0392	RES FXD COMP 3X9 K	599589
3	R 26	200-0102	RES FXD COMP 1 K	599589
14	R 27	200-0822	RES FXD COMP 8X2 K	599589
9	R 28	200-0332	RES FXD COMP 3X3 K	599589
13	R 29	200-0821	RES FXD COMP 820 OHM	599589
2	R 30	200-0101	RES FXD COMP 100 OHM	599589
3	R 31	200-0102	RES FXD COMP 1 K	599589
14	R 32	200-0822	RES FXD COMP 8X2 K	599589
10	R 33	200-0392	RES FXD COMP 3X9 K	599589
8	R 34	200-0273	RES FXD COMP 27 K	599589
4	R 35	200-0103	RES FXD COMP 10 K	599589
7	R 36	200-0272	RES FXD COMP 2X7 K	599589
11	R 37	200-0561	RES FXD COMP 560 OHM	599589
34	R 38	211-1102	RES FXD FILM 11XOK	599589
13	R 39	200-0821	RES FXD COMP 820 OHM	599589
4	R 40	200-0103	RES FXD COMP 10 K	599589
3	R 41	200-0102	RES FXD COMP 1 K	599589
14	R 42	200-0822	RES FXD COMP 8X2 K	599589
10	R 43	200-0392	RES FXD COMP 3X9 K	599589
13	R 44	200-0821	RES FXD COMP 820 OHM	599589
2	R 45	200-0101	RES FXD COMP 100 OHM	599589
3	R 46	200-0102	RES FXD COMP 1 K	599589
14	R 47	200-0822	RES FXD COMP 8X2 K	599589
10	R 48	200-0392	RES FXD COMP 3X9 K	599589
3	R 49	200-0102	RES FXD COMP 1 K	599589
14	R 50	200-0822	RES FXD COMP 8X2 K	599589
10	R 51	200-0392	RES FXD COMP 3X9 K	599589
13	R 52	200-0821	RES FXD COMP 820 OHM	599589
2	R 53	200-0101	RES FXD COMP 100 OHM	599589
3	R 54	200-0102	RES FXD COMP 1 K	599589
14	R 55	200-0822	RES FXD COMP 8X2 K	599589
10	R 56	200-0392	RES FXD COMP 3X9 K	599589
3	R 57	200-0102	RES FXD COMP 1 K	599589
14	R 58	200-0822	RES FXD COMP 8X2 K	599589
10	R 59	200-0392	RES FXD COMP 3X9 K	599589
13	R 60	200-0821	RES FXD COMP 820 OHM	599589
2	R 61	200-0101	RES FXD COMP 100 OHM	599589
3	R 62	200-0102	RES FXD COMP 1 K	599589
14	R 63	200-0822	RES FXD COMP 8X2 K	599589
10	R 64	200-0392	RES FXD COMP 3X9 K	599589
3	R 65	200-0102	RES FXD COMP 1 K	599589
14	R 66	200-0822	RES FXD COMP 8X2 K	599589
10	R 67	200-0392	RES FXD COMP 3X9 K	599589
13	R 68	200-0821	RES FXD COMP 820 OHM	599589
2	R 69	200-0101	RES FXD COMP 100 OHM	599589
3	R 70	200-0102	RES FXD COMP 1 K	599589
14	R 71	200-0822	RES FXD COMP 8X2 K	599589
10	R 72	200-0392	RES FXD COMP 3X9 K	599589
8	R 73	200-0273	RES FXD COMP 27 K	599589
4	R 74	200-0103	RES FXD COMP 10 K	599589
4	R 77	200-0103	RES FXD COMP 10 K	599589
13	R 78	200-0821	RES FXD COMP 820 OHM	599589
4	R 79	200-0103	RES FXD COMP 10 K	599589
3	R 80	200-0102	RES FXD COMP 1 K	599589
14	R 81	200-0822	RES FXD COMP 8X2 K	599589
10	R 82	200-0392	RES FXD COMP 3X9 K	599589
13	R 83	200-0821	RES FXD COMP 820 OHM	599589
2	R 84	200-0101	RES FXD COMP 100 OHM	599589
3	R 85	200-0102	RES FXD COMP 1 K	599589
14	R 86	200-0822	RES FXD COMP 8X2 K	599589
10	R 87	200-0392	RES FXD COMP 3X9 K	599589
3	R 88	200-0102	RES FXD COMP 1 K	599589
14	R 89	200-0822	RES FXD COMP 8X2 K	599589
10	R 90	200-0392	RES FXD COMP 3X9 K	599589
13	R 91	200-0821	RES FXD COMP 820 OHM	599589
2	R 92	200-0101	RES FXD COMP 100 OHM	599589
3	R 93	200-0102	RES FXD COMP 1 K	599589
14	R 94	200-0822	RES FXD COMP 8X2 K	599589

ITEM NUMBER	REFERENCE DESIGNATION	T R A C O R STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
10	R 95	200-0392	RES FXD COMP 3X9 K	599589
3	R 96	200-0102	RES FXD COMP 1 K	599589
14	R 97	200-0822	RES FXD COMP 8X2 K	599589
10	R 98	200-0392	RES FXD COMP 3X9 K	599589
13	R 99	200-0821	RES FXD COMP 820 OHM	599589
2	R 100	200-0101	RES FXD COMP 100 OHM	599589
3	R 101	200-0102	RES FXD COMP 1 K	599589
14	R 102	200-0822	RES FXD COMP 8X2 K	599589
10	R 103	200-0392	RES FXD COMP 3X9 K	599589
6	R 104	200-0183	RES FXD COMP 18 K	599589
12	R 105	200-0562	RES FXD COMP 5X6 K	599589
4	R 106	200-0103	RES FXD COMP 10 K	599589
9	R 107	200-0332	RES FXD COMP 3X3 K	599589
5	R 108	200-0122	RES FXD COMP 1X2 K	599589
4	R 109	200-0103	RES FXD COMP 10 K	599589
13	R 110	200-0821	RES FXD COMP 820 OHM	599589
4	R 111	200-0103	RES FXD COMP 10 K	599589
4	R 112	200-0103	RES FXD COMP 10 K	599589
13	R 113	200-0821	RES FXD COMP 820 OHM	599589
10	R 114	200-0392	RES FXD COMP 3X9 K	599589
12	R 115	200-0562	RES FXD COMP 5X6 K	599589
8	R 116	200-0273	RES FXD COMP 27 K	599589
2	R 117	200-0101	RES FXD COMP 100 OHM	599589
2	R 118	200-0101	RES FXD COMP 100 OHM	599589
15	CR 1	801-0096	DIODE 1N96A	599589
15	CR 2	801-0096	DIODE 1N96A	599589
15	CR 3	801-0096	DIODE 1N96A	599589
15	CR 4	801-0096	DIODE 1N96A	599589
15	CR 5	801-0096	DIODE 1N96A	599589
15	CR 6	801-0096	DIODE 1N96A	599589
15	CR 7	801-0096	DIODE 1N96A	599589
15	CR 8	801-0096	DIODE 1N96A	599589
15	CR 9	801-0096	DIODE 1N96A	599589
15	CR 10	801-0096	DIODE 1N96A	599589
15	CR 11	801-0096	DIODE 1N96A	599589
15	CR 12	801-0096	DIODE 1N96A	599589
15	CR 13	801-0096	DIODE 1N96A	599589
15	CR 14	801-0096	DIODE 1N96A	599589
15	CR 15	801-0096	DIODE 1N96A	599589
15	CR 16	801-0096	DIODE 1N96A	599589
15	CR 17	801-0096	DIODE 1N96A	599589
15	CR 18	801-0096	DIODE 1N96A	599589
15	CR 19	801-0096	DIODE 1N96A	599589
15	CR 20	801-0096	DIODE 1N96A	599589
15	CR 21	801-0096	DIODE 1N96A	599589
15	CR 22	801-0096	DIODE 1N96A	599589
15	CR 23	801-0096	DIODE 1N96A	599589
			ASSY PCB	599590
1		82	INSULATOR TSTR	599590
42		3326-0046	RIVET POP	599590
48		3657-0001	INSULATOR TSTR	599590
52		21472-0003	INK MARKING AS REQD	599590
54		599185	BOARD PRINTED CIRCUIT	599590
49	C 1	8917-0121	CAP 120 MFD 10V	599590
49	C 2	8917-0121	CAP 120 MFD 10V	599590
50	C 3	8917-9471	CAP 4X7 MFD 10V	599590
45	C 4	3612-9223	CAP X022 MFD 200V	599590
40	C 5	3319-0471	CAP 470 PFD 1000V	599590
40	C 6	3319-0471	CAP 470 PFD 1000V	599590
40	C 7	3319-0471	CAP 470 PFD 1000V	599590
40	C 8	3319-0471	CAP 470 PFD 1000V	599590
44	C 9	3612-9102	CAP X1 MFD 200	599590
51	C 10	8918-0331	CAP 330 MFD 6V	599590
51	C 11	8918-0331	CAP 330 MFD 6V	599590
50	C 12	8917-9471	CAP 4X7 MFD 10V	599590
40	C 13	3319-0471	CAP 470 PFD 1000V	599590
40	C 14	3319-0471	CAP 470 PFD 1000V	599590
41	C 15	3321-9102	CAP X1 MFD 10V	599590
49	C 17	8917-0121	CAP 120 MFD 10V	599590
40	C 18	3319-0471	CAP 470 PFD 1000V	599590
40	C 19	3319-0471	CAP 470 PFD 1000V	599590
40	C 20	3319-0471	CAP 470 PFD 1000V	599590
40	C 21	3319-0471	CAP 470 PFD 1000V	599590
47	C 22	3656-5001	CAP X005 MFD 100V	599590
53	C 23	27513-0561	CAP 560 PFD 300V	599590
50	C 24	8917-9471	CAP 4X7 MFD 10V	599590
51	C 25	8918-0331	CAP 330 MFD 6V	599590
49	C 26	8917-0121	CAP 120 MFD 10V	599590
49	C 27	8917-0121	CAP 120 MFD 10V	599590
40	C 28	3319-0471	CAP 470 PFD 1000V	599590
41	C 29	3321-9102	CAP X1 MFD 10V	599590
43	L 1	3568-0101	INDUCTOR 100 UH	599590

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
39	P 1	3318-0028	CONN 22P	599590
37	Q 1	900-2270	TSTR NPN 2N2270	599590
38	Q 2	900-2280	TSTR PNP 2N2280	599590
34	Q 3	900-1304	TSTR NPN 2N1304	599590
34	Q 4	900-1304	TSTR NPN 2N1304	599590
38	Q 5	900-2280	TSTR PNP 2N2280	599590
36	Q 6	900-2102	TSTR NPN 2N2102	599590
37	Q 7	900-2270	TSTR NPN 2N2270	599590
37	Q 8	900-2270	TSTR NPN 2N2270	599590
37	Q 9	900-2270	TSTR NPN 2N2270	599590
35	Q 10	900-1305	TSTR PNP 2N1305	599590
35	Q 11	900-1305	TSTR PNP 2N1305	599590
37	Q 12	900-2270	TSTR NPN 2N2270	599590
37	Q 13	900-2270	TSTR NPN 2N2270	599590
34	Q 14	900-1304	TSTR NPN 2N1304	599590
34	Q 15	900-1304	TSTR NPN 2N1304	599590
34	Q 17	900-1304	TSTR NPN 2N1304	599590
34	Q 18	900-1304	TSTR NPN 2N1304	599590
35	Q 19	900-1305	TSTR PNP 2N1305	599590
34	Q 20	900-1304	TSTR NPN 2N1304	599590
37	Q 21	900-2270	TSTR NPN 2N2270	599590
37	Q 22	900-2270	TSTR NPN 2N2270	599590
37	Q 23	900-2270	TSTR NPN 2N2270	599590
33	Q 24	900-0963	TSTR PNP 2N963	599590
2	R 1	200-0100	RES FXD COMP 10 OHM	599590
2	R 2	200-0100	RES FXD COMP 10 OHM	599590
21	R 3	205-1212	RES FXD FILM 12X1 K	599590
27	R 4	205-2373	RES FXD FILM 237 K	599590
23	R 5	205-1471	RES FXD FILM 1X47 K	599590
4	R 6	200-0102	RES FXD COMP I K	599590
26	R 7	205-2151	RES FXD FILM 2X15 K	599590
25	R 8	205-1962	RES FXD FILM 19X6 K	599590
18	R 9	200-0681	RES FXD COMP 680 OHM	599590
15	R 10	200-0470	RES FXD COMP 47 OHM	599590
26	R 11	205-2151	RES FXD FILM 2X15 K	599590
9	R 12	200-0221	RES FXD COMP 220 OHM	599590
29	R 13	205-2871	RES FXD FILM 2X87 K	599590
12	R 14	200-0272	RES FXD COMP 2X7 K	599590
8	R 15	200-0182	RES FXD COMP 1X8 K	599590
10	R 16	200-0222	RES FXD COMP 2X2 K	599590
5	R 17	200-0103	RES FXD COMP 10 K	599590
6	R 18	200-0152	RES FXD COMP 1X5 K	599590
8	R 19	200-0182	RES FXD COMP 1X8 K	599590
13	R 20	200-0273	RES FXD COMP 27 K	599590
17	R 21	200-0562	RES FXD COMP 5X6 K	599590
3	R 22	200-0101	RES FXD COMP 100 OHM	599590
17	R 23	200-0562	RES FXD COMP 5X6 K	599590
13	R 24	200-0273	RES FXD COMP 27 K	599590
8	R 25	200-0182	RES FXD COMP 1X8 K	599590
2	R 27	200-0100	RES FXD COMP 10 OHM	599590
7	R 28	200-0153	RES FXD COMP 15 K	599590
30	R 29	205-3839	RES FXD FILM 38X3 OHM	599590
22	R 30	205-1331	RES FXD FILM 1X33 K	599590
28	R 31	205-2611	RES FXD FILM 2X61 K	599590
46	R 32	3651-0152	SENSISTOR 1X5 K 1/4W	599590
12	R 33	200-0272	RES FXD COMP 2X7 K	599590
11	R 34	200-0223	RES FXD COMP 22 K	599590
19	R 35	200-0682	RES FXD COMP 6X8 K	599590
17	R 36	200-0562	RES FXD COMP 5X6 K	599590
3	R 37	200-0101	RES FXD COMP 100 OHM	599590
8	R 38	200-0182	RES FXD COMP 1X8 K	599590
11	R 39	200-0223	RES FXD COMP 22 K	599590
19	R 40	200-0682	RES FXD COMP 6X8 K	599590
17	R 41	200-0562	RES FXD COMP 5X6 K	599590
20	R 42	200-0823	RES FXD COMP 82 K	599590
7	R 43	200-0153	RES FXD COMP 15 K	599590
16	R 44	200-0473	RES FXD COMP 47 K	599590
16	R 45	200-0473	RES FXD COMP 47 K	599590
14	R 46	200-0392	RES FXD COMP 3X9 K	599590
3	R 47	200-0101	RES FXD COMP 100 OHM	599590
14	R 48	200-0392	RES FXD COMP 3X9 K	599590
21	R 49	205-1212	RES FXD FILM 12X1 K	599590
31	R 50	205-4221	RES FXD FILM 4X22 K	599590
12	R 51	200-0272	RES FXD COMP 2X7 K	599590
24	R 52	205-1781	RES FXD FILM 1X78 K	599590
24	R 53	205-1781	RES FXD FILM 1X78 K	599590
8	R 54	200-0182	RES FXD COMP 1X8 K	599590
24	R 55	205-1781	RES FXD FILM 1X78 K	599590
8	R 56	200-0182	RES FXD COMP 1X8 K	599590
11	R 57	200-0223	RES FXD COMP 22 K	599590
17	R 58	200-0562	RES FXD COMP 5X6 K	599590
19	R 59	200-0682	RES FXD COMP 6X8 K	599590
3	R 60	200-0101	RES FXD COMP 100 OHM	599590
8	R 61	200-0182	RES FXD COMP 1X8 K	599590
11	R 62	200-0223	RES FXD COMP 22 K	599590

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
19	R 63	200-0682	RES FXD COMP 6X8 K	599590
17	R 64	200-0562	RES FXD COMP 5X6 K	599590
32	CR 1	801-0096	DIODE IN96A	599590
32	CR 2	801-0096	DIODE IN96A	599590
32	CR 3	801-0096	DIODE IN96A	599590
32	CR 4	801-0096	DIODE IN96A	599590
			ASSY PCB	599591
1		82	INSULATOR TSTR	599591
42		3326-0046	RIVET POP	599591
47		3657-0001	INSULATOR TSTR	599591
51		21472-0003	INK MARKING AS REQ	599591
52		599186	BOARD PRINTED CIRCUIT	599591
38	C 1	3319-0271	CAP 270 PFD 1000V	599591
41	C 3	3321-9102	CAP X1 MFD 10V	599591
39	C 4	3319-0471	CAP 470 PFD 1000V	599591
39	C 5	3319-0471	CAP 470 PFD 1000V	599591
39	C 6	3319-0471	CAP 470 PFD 1000V	599591
39	C 7	3319-0471	CAP 470 PFD 1000V	599591
39	C 8	3319-0471	CAP 470 PFD 1000V	599591
39	C 9	3319-0471	CAP 470 PFD 1000V	599591
40	C 10	3319-0751	CAP 750 PFD 1000V	599591
39	C 13	3319-0471	CAP 470 PFD 1000V	599591
49	C 14	8917-9471	CAP 4X7 MFD 10V	599591
46	C 15	3612-9102	CAP X1 MFD 200V	599591
45	C 16	3611-9472	CAP X47 MFD 200V	599591
49	C 17	8917-9471	CAP 4X7 MFD 10V	599591
38	C 18	3319-0271	CAP 270 PFD 1000V	599591
39	C 19	3319-0471	CAP 470 PFD 1000V	599591
44	C 20	3567-9401	CAP 4 MFD 50V	599591
38	C 21	3319-0271	CAP 270 PFD 1000V	599591
50	C 22	8918-0560	CAP 56 MFD 6V	599591
50	C 23	8918-0560	CAP 56 MFD 6V	599591
48	C 24	8917-0121	CAP 120 MFD 10V	599591
37	P 1	3318-0028	CONN 22P	599591
32	Q 1	900-1304	TSTR NPN 2N1304	599591
32	Q 2	900-1304	TSTR NPN 2N1304	599591
32	Q 3	900-1304	TSTR NPN 2N1304	599591
32	Q 4	900-1304	TSTR NPN 2N1304	599591
32	Q 5	900-1304	TSTR NPN 2N1304	599591
32	Q 6	900-1304	TSTR NPN 2N1304	599591
32	Q 7	900-1304	TSTR NPN 2N1304	599591
36	Q 8	900-2280	TSTR PNP 2N2280	599591
35	Q 9	900-2270	TSTR NPN 2N2270	599591
32	Q 10	900-1304	TSTR NPN 2N1304	599591
32	Q 11	900-1304	TSTR NPN 2N1304	599591
35	Q 12	900-2270	TSTR NPN 2N2270	599591
36	Q 13	900-2280	TSTR PNP 2N2280	599591
32	Q 14	900-1304	TSTR NPN 2N1304	599591
33	Q 15	900-1305	TSTR PNP 2N1305	599591
36	Q 16	900-2280	TSTR PNP 2N2280	599591
36	Q 17	900-2280	TSTR PNP 2N2280	599591
35	Q 18	900-2270	TSTR NPN 2N2270	599591
36	Q 19	900-2280	TSTR PNP 2N2280	599591
32	Q 20	900-1304	TSTR NPN 2N1304	599591
34	Q 21	900-2102	TSTR NPN 2N2102	599591
33	Q 22	900-1305	TSTR PNP 2N1305	599591
33	Q 23	900-1305	TSTR PNP 2N1305	599591
35	Q 24	900-2270	TSTR NPN 2N2270	599591
22	R 1	200-0562	RES FXD COMP 5X6 K	599591
8	R 2	200-0182	RES FXD COMP 1X8 K	599591
10	R 3	200-0223	RES FXD COMP 22 K	599591
23	R 4	200-0682	RES FXD COMP 6X8 K	599591
3	R 5	200-0101	RES FXD COMP 100 OHM	599591
23	R 6	200-0682	RES FXD COMP 6X8 K	599591
10	R 7	200-0223	RES FXD COMP 22 K	599591
8	R 8	200-0182	RES FXD COMP 1X8 K	599591
22	R 9	200-0562	RES FXD COMP 5X6 K	599591
17	R 10	200-0391	RES FXD COMP 390 OHM	599591
7	R 11	200-0152	RES FXD COMP 1X5 K	599591
10	R 12	200-0223	RES FXD COMP 22 K	599591
22	R 13	200-0562	RES FXD COMP 5X6 K	599591
3	R 14	200-0101	RES FXD COMP 100 OHM	599591
16	R 15	200-0333	RES FXD COMP 33 K	599591
16	R 16	200-0333	RES FXD COMP 33 K	599591
10	R 17	200-0223	RES FXD COMP 22 K	599591
8	R 18	200-0182	RES FXD COMP 1X8 K	599591
5	R 19	200-0103	RES FXD COMP 10 K	599591
22	R 20	200-0562	RES FXD COMP 5X6 K	599591
19	R 21	200-0472	RES FXD COMP 4X7 K	599591
22	R 22	200-0562	RES FXD COMP 5X6 K	599591
8	R 23	200-0182	RES FXD COMP 1X8 K	599591
10	R 24	200-0223	RES FXD COMP 22 K	599591

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
23	R 25	200-0682	RES FXD COMP 6X8 K	599591
3	R 26	200-0101	RES FXD COMP 100 OHM	599591
23	R 27	200-0682	RES FXD COMP 6X8 K	599591
22	R 28	200-0562	RES FXD COMP 5X6 K	599591
9	R 29	200-0183	RES FXD COMP 18 K	599591
24	R 30	200-0821	RES FXD COMP 820 OHM	599591
29	R 31	204-0821	RES FXD COMP 820 OHM	599591
28	R 32	204-0681	RES FXD COMP 680 OHM	599591
16	R 33	200-0333	RES FXD COMP 33 K	599591
27	R 34	204-0221	RES FXD COMP 220 OHM	599591
21	R 35	200-0561	RES FXD COMP 560 OHM	599591
15	R 36	200-0332	RES FXD COMP 3X3 K	599591
8	R 37	200-0182	RES FXD COMP 1X8 K	599591
25	R 38	200-0822	RES FXD COMP 8X2 K	599591
13	R 39	200-0272	RES FXD COMP 2X7 K	599591
5	R 40	200-0103	RES FXD COMP 10 K	599591
12	R 41	200-0271	RES FXD COMP 270 OHM	599591
22	R 42	200-0562	RES FXD COMP 5X6 K	599591
5	R 43	200-0103	RES FXD COMP 10 K	599591
2	R 44	200-0100	RES FXD COMP 10 OHM	599591
19	R 45	200-0472	RES FXD COMP 4X7 K	599591
22	R 46	200-0562	RES FXD COMP 5X6 K	599591
2	R 47	200-0100	RES FXD COMP 10 OHM	599591
13	R 48	200-0272	RES FXD COMP 2X7 K	599591
14	R 49	200-0273	RES FXD COMP 27 K	599591
20	R 50	200-0475	RES FXD COMP 4X7 M	599591
18	R 51	200-0470	RES FXD COMP 47 OHM	599591
18	R 52	200-0470	RES FXD COMP 47 OHM	599591
3	R 53	200-0101	RES FXD COMP 100 OHM	599591
26	R 54	200-0823	RES FXD COMP 82 K	599591
2	R 55	200-0100	RES FXD COMP 10 OHM	599591
13	R 56	200-0272	RES FXD COMP 2X7 K	599591
2	R 57	200-0100	RES FXD COMP 10 OHM	599591
16	R 58	200-0333	RES FXD COMP 33 K	599591
11	R 59	200-0224	RES FXD COMP 220 K	599591
6	R 60	200-0125	RES FXD COMP 1X2 M	599591
8	R 61	200-0182	RES FXD COMP 1X8 K	599591
4	R 62	200-0102	RES FXD COMP 1 K OHM	599591
2	R 63	200-0100	RES FXD COMP 10 OHM	599591
31	CR 1	801-0096	DIODE 1N96A	599591
31	CR 2	801-0096	DIODE 1N96A	599591
31	CR 3	801-0096	DIODE 1N96A	599591
31	CR 4	801-0096	DIODE 1N96A	599591
31	CR 5	801-0096	DIODE 1N96A	599591
31	CR 6	801-0096	DIODE 1N96A	599591
31	CR 8	801-0096	DIODE 1N96A	599591
31	CR 9	801-0096	DIODE 1N96A	599591
31	CR 10	801-0096	DIODE 1N96A	599591
31	CR 11	801-0096	DIODE 1N96A	599591
43	CR 12	3432-0001	DIODE G129	599591
30	VR 1	800-0750	DIODE 1N750	599591
			ASSY PCB	599592
1		599187	BOARD PRINTED CIRCUIT	599592
3		82	INSULATOR TSTR	599592
43		3326-0046	RIVET POP	599592
47	C 1	3611-9473	CAP X047 MFD 200V	599592
49	C 2	8917-0121	CAP 120 MFD 10V	599592
53	C 3	27513-0561	CAP 560 PFD 300V	599592
42	C 4	3324-9394	CAP X0039 MFD 200V	599592
41	C 5	3324-9154	CAP X0015 MFD 200V	599592
40	C 6	3324-9104	CAP X001 MFD 200V	599592
49	C 7	8917-0121	CAP 120 MFD 10V	599592
47	C 8	3611-9473	CAP X047 MFD 200V	599592
53	C 9	27513-0561	CAP 560 PFD 300V	599592
50	C 10	8917-9471	CAP 4X7 MFD 10V	599592
50	C 11	8917-9471	CAP 4X7 MFD 10V	599592
48	C 12	3656-5001	CAP X005 MFD 100V	599592
48	C 13	3656-5001	CAP X005 MFD 100V	599592
48	C 14	3656-5001	CAP X005 MFD 100V	599592
48	C 15	3656-5001	CAP X005 MFD 100V	599592
48	C 16	3656-5001	CAP X005 MFD 100V	599592
50	C 17	8917-9471	CAP 4X7 MFD 10V	599592
51	C 18	8918-0560	CAP 56 MFD 6V	599592
39	C 19	3319-0471	CAP 470 PFD 1000V	599592
39	C 20	3319-0471	CAP 470 PFD 1000V	599592
39	C 21	3319-0471	CAP 470 PFD 1000V	599592
39	C 22	3319-0471	CAP 470 PFD 1000V	599592
39	C 23	3319-0471	CAP 470 PFD 1000V	599592
39	C 24	3319-0471	CAP 470 PFD 1000V	599592
39	C 25	3319-0471	CAP 470 PFD 1000V	599592
52	C 26	27513-0471	CAP 470 PFD 500V	599592
44	L 1	3422-0472	INDUCTOR 4700 UH	599592

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
45	L 2	3568-0201	INDUCTOR 200 UH	599592
45	L 3	3568-0201	INDUCTOR 200 UH	599592
45	L 4	3568-0201	INDUCTOR 200 UH	599592
45	L 5	3568-0201	INDUCTOR 200 UH	599592
45	L 6	3568-0201	INDUCTOR 200 UH	599592
44	L 7	3422-0472	INDUCTOR 4700 UH	599592
44	L 8	3422-0472	INDUCTOR 4700 UH	599592
2	P 1	3318-0028	CONN 22P	599592
37	Q 1	900-1305	TSTR PNP 2N1305	599592
37	Q 2	900-1305	TSTR PNP 2N1305	599592
37	Q 3	900-1305	TSTR PNP 2N1305	599592
37	Q 4	900-1305	TSTR PNP 2N1305	599592
37	Q 5	900-1305	TSTR PNP 2N1305	599592
37	Q 6	900-1305	TSTR PNP 2N1305	599592
37	Q 7	900-1305	TSTR PNP 2N1305	599592
38	Q 8	900-2270	TSTR NPN 2N2270	599592
37	Q 9	900-1305	TSTR PNP 2N1305	599592
38	Q 10	900-2270	TSTR NPN 2N2270	599592
37	Q 11	900-1305	TSTR PNP 2N1305	599592
37	Q 12	900-1305	TSTR PNP 2N1305	599592
38	Q 13	900-2270	TSTR NPN 2N2270	599592
37	Q 14	900-1305	TSTR PNP 2N1305	599592
37	Q 15	900-1305	TSTR PNP 2N1305	599592
38	Q 16	900-2270	TSTR NPN 2N2270	599592
37	Q 17	900-1305	TSTR PNP 2N1305	599592
38	Q 18	900-2270	TSTR NPN 2N2270	599592
37	Q 19	900-1305	TSTR PNP 2N1305	599592
37	Q 20	900-1305	TSTR PNP 2N1305	599592
36	Q 21	900-1304	TSTR NPN 2N1304	599592
37	Q 22	900-1305	TSTR PNP 2N1305	599592
37	Q 23	900-1305	TSTR PNP 2N1305	599592
37	Q 24	900-1305	TSTR PNP 2N1305	599592
37	Q 25	900-1305	TSTR PNP 2N1305	599592
37	Q 26	900-1305	TSTR PNP 2N1305	599592
37	Q 27	900-1305	TSTR PNP 2N1305	599592
37	Q 28	900-1305	TSTR PNP 2N1305	599592
37	Q 29	900-1305	TSTR PNP 2N1305	599592
37	Q 30	900-1305	TSTR PNP 2N1305	599592
4	R 1	200-0100	RES FXD COMP 10 OHM	599592
19	R 2	200-0391	RES FXD COMP 390 OHM	599592
12	R 3	200-0222	RES FXD COMP 2X2 K	599592
17	R 4	200-0332	RES FXD COMP 3X3 K	599592
6	R 5	200-0102	RES FXD COMP 1 K	599592
7	R 6	200-0103	RES FXD COMP 10 K	599592
21	R 7	200-0472	RES FXD COMP 4X7 K	599592
8	R 9	200-0152	RES FXD COMP 1X5 K	599592
23	R 10	200-0681	RES FXD COMP 680 OHM	599592
9	R 11	200-0153	RES FXD COMP 15 K	599592
6	R 12	200-0102	RES FXD COMP 1 K	599592
18	R 13	200-0333	RES FXD COMP 33 K	599592
13	R 14	200-0224	RES FXD COMP 220 K	599592
24	R 15	205-1181	RES FXD FILM 1X18 K	599592
8	R 16	200-0152	RES FXD COMP 1X5 K	599592
29	R 17	205-2430	RES FXD FILM 243 OHM	599592
24	R 18	205-1181	RES FXD FILM 1X18 K	599592
20	R 19	200-0471	RES FXD COMP 470 OHM	599592
25	R 20	205-1472	RES FXD COMP 14X7 K	599592
29	R 21	205-2430	RES FXD FILM 243 OHM	599592
34	R 22	205-9310	RES FXD COMP 931 OHM	599592
20	R 23	200-0471	RES FXD COMP 470 OHM	599592
5	R 24	200-0101	RES FXD COMP 100 OHM	599592
32	R 25	205-7322	RES FXD FILM 73X2 K	599592
14	R 26	200-0272	RES FXD COMP 2X7 K	599592
29	R 27	205-2430	RES FXD FILM 243 OHM	599592
24	R 28	205-1181	RES FXD FILM 1X18 K	599592
20	R 29	200-0471	RES FXD COMP 470 OHM	599592
5	R 30	200-0101	RES FXD COMP 100 OHM	599592
26	R 31	205-1503	RES FXD FILM 150 K	599592
14	R 32	200-0272	RES FXD COMP 2X7 K	599592
29	R 33	205-2430	RES FXD FILM 243 OHM	599592
34	R 34	205-9310	RES FXD COMP 931 OHM	599592
20	R 35	200-0471	RES FXD COMP 470 OHM	599592
28	R 36	205-2000	RES FXD FILM 200 OHM	599592
33	R 37	205-7323	RES FXD FILM 732 K	599592
20	R 38	200-0471	RES FXD COMP 470 OHM	599592
5	R 39	200-0101	RES FXD COMP 100 OHM	599592
27	R 40	205-1504	RES FXD FILM 1X5 M	599592
14	R 41	200-0272	RES FXD COMP 2X7 K	599592
5	R 42	200-0101	RES FXD COMP 100 OHM	599592
20	R 43	200-0471	RES FXD COMP 470 OHM	599592
8	R 44	200-0152	RES FXD COMP 1X5 K	599592
30	R 45	205-4220	RES FXD FILM 422 OHM	599592
46	R 46	3596-0101	RES VAR 100 OHM 1/2 W	599592
31	R 47	205-4640	RES FXD FILM 464 OHM	599592
11	R 48	200-0221	RES FXD COMP 220 OHM	599592

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
18	R 49	200-0333	RES FXD COMP 33 K	599592
8	R 50	200-0152	RES FXD COMP 1X5 K	599592
18	R 51	200-0333	RES FXD COMP 33 K	599592
22	R 52	200-0562	RES FXD COMP 5X6 K	599592
18	R 53	200-0333	RES FXD COMP 33 K	599592
10	R 54	200-0182	RES FXD COMP 1X8 K	599592
10	R 55	200-0182	RES FXD COMP 1X8 K	599592
15	R 56	200-0273	RES FXD COMP 27 K	599592
15	R 57	200-0273	RES FXD COMP 27 K	599592
22	R 58	200-0562	RES FXD COMP 5X6 K	599592
5	R 59	200-0101	RES FXD COMP 100 OHM	599592
22	R 60	200-0562	RES FXD COMP 5X6 K	599592
16	R 61	200-0331	RES FXD COMP 330 OHM	599592
17	R 62	200-0332	RES FXD COMP 3X3 K	599592
7	R 63	200-0103	RES FXD COMP 10 K	599592
22	R 64	200-0562	RES FXD COMP 5X6 K	599592
5	R 65	200-0101	RES FXD COMP 100 OHM	599592
22	R 66	200-0562	RES FXD COMP 5X6 K	599592
15	R 67	200-0273	RES FXD COMP 27 K	599592
15	R 68	200-0273	RES FXD COMP 27 K	599592
10	R 69	200-0182	RES FXD COMP 1X8 K	599592
10	R 70	200-0182	RES FXD COMP 1X8 K	599592
8	R 71	200-0152	RES FXD COMP 1X5 K	599592
18	R 72	200-0333	RES FXD COMP 33 K	599592
16	R 73	200-0331	RES FXD COMP 330 OHM	599592
22	R 74	200-0562	RES FXD COMP 5X6 K	599592
17	R 75	200-0332	RES FXD COMP 3X3 K	599592
4	R 76	200-0100	RES FXD COMP 10 OHM	599592
21	R 77	200-0472	RES FXD COMP 4X7 K	599592
35	CR 1	801-0096	DIODE IN96A	599592
35	CR 2	801-0096	DIODE IN96A	599592
35	CR 3	801-0096	DIODE IN96A	599592
35	CR 4	801-0096	DIODE IN96A	599592
35	CR 5	801-0096	DIODE IN96A	599592
35	CR 6	801-0096	DIODE IN96A	599592
			ASSY PCB COARSE TUNIN	599593
11		21472-0003	INK MARKING	599593
12		599196	BOARD PRINTED CIRCUIT	599593
9	R 1	205-7152	RES FXD FILM 71X5 K	599593
2	R 2	205-1542	RES FXD FILM 15X4 K	599593
3	R 3	205-1782	RES FXD FILM 17X8 K	599593
4	R 4	205-2052	RES FXD FILM 20X5 K	599593
5	R 5	205-2372	RES FXD FILM 23X7 K	599593
6	R 6	205-2872	RES FXD FILM 28X7 K	599593
7	R 7	205-3572	RES FXD FILM 35X7 K	599593
8	R 8	205-4872	RES FXD FILM 48X7 K	599593
9	R 9	205-7152	RES FXD FILM 71X5 K	599593
1	R 10	205-1473	RES FXD FILM 147 K	599593
10	R 11	205-7321	RES FXD FILM 7X32 K	599593
2	R 12	205-1542	RES FXD FILM 15X4 K	599593
			ASSY	599594
7		21472-0003	INK MARKING	599594
9		599289	BOARD PRINTED CIRCUIT	599594
0	A 1		ASSY PCB BB FIL/ETC	599594
5	C 1	3656-1003	CAP X1 MFD 100 V	599594
5	C 2	3656-1003	CAP X1 MFD 100 V	599594
6	C 3	3656-2003	CAP X2 MFD 100 V	599594
3	C 5	3340-0100	CAP 10 MFD 25 V	599594
8	C 7	21485-9101	CAP 1 MFD 35 V	599594
4	R 14	3598-0503	RES VAR 50 K	599594
2	R 15	205-8060	RES FXD FILM 806 OHM	599594
1	R 16	205-1621	RES FXD FILM 1X62 K	599594
1	R 17	205-1621	RES FXD FILM 1X62 K	599594
			ASSY	599595
4		21472-0003	INK MARKING	599595
5		599290	BOARD PRINTED CIRCUIT	599595
0	A 1		ASSY PCB ATTENUATOR	599595
3	R 27	204-0331	RES FXD COMP 330 OHM	599595
3	R 28	204-0331	RES FXD COMP 330 OHM	599595
3	R 29	204-0331	RES FXD COMP 330 OHM	599595
3	R 30	204-0331	RES FXD COMP 330 OHM	599595
3	R 31	204-0331	RES FXD COMP 330 OHM	599595
3	R 32	204-0331	RES FXD COMP 330 OHM	599595
3	R 33	204-0331	RES FXD COMP 330 OHM	599595
3	R 34	204-0331	RES FXD COMP 330 OHM	599595
2	R 35	204-0221	RES FXD COMP 220 OHM	599595

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
2	R 36	204-0221	RES FXD COMP 220 OHM	599595
2	R 37	204-0221	RES FXD COMP 220 OHM	599595
2	R 38	204-0221	RES FXD COMP 220 OHM	599595
2	R 39	204-0221	RES FXD COMP 220 OHM	599595
2	R 40	204-0221	RES FXD COMP 220 OHM	599595
2	R 41	204-0221	RES FXD COMP 220 OHM	599595
1	R 42	204-0151	RES FXD COMP 150 OHM	599595
			ASSY PCB	599596
1		82	INSULATOR TSTR	599596
2		177-0020	SCREW BIND HD 6 32	599596
26		617-0267	WASHER FLAT NO 6	599596
27		617-0270	WASHER FLAT NO 8	599596
28		620-0125	WASHER LOCK IT NO 6	599596
29		620-0126	WASHER LOCK IT NO 8	599596
30		649-0114	NUT 6 32	599596
31		649-0134	NUT 8 32	599596
48		21472-0003	INK MARKING	599596
49		599058	HEATSINK	599596
50		599355	BOARD PRINTED CIRCUIT	599596
44	C 1	3335-0101	CAP 100 MFD 3V	599596
47	C 2	3611-9473	CAP X047 MFD 200V	599596
43	C 3	3324-9475	CAP 470 PFD 200V	599596
42	C 4	3324-9104	CAP X001 MFD 200V	599596
41	C 5	3317-9332	CAP X33 MFD 200V	599596
45	C 6	3338-0251	CAP 250 MFD 12V	599596
45	C 7	3338-0251	CAP 250 MFD 12V	599596
45	C 8	3338-0251	CAP 250 MFD 12V	599596
42	C 9	3324-9104	CAP X001 MFD 200V	599596
38	Q 3	900-1995	TSTR NPN 2N1995	599596
37	Q 4	900-1319	TSTR PNP 2N1319	599596
51	Q 5	599391	TSTR MATCHED W Q 6	599596
51	Q 6	599391	TSTR MATCHED W Q 5	599596
40	Q 7	900-3134	TSTR PNP 2N3134	599596
40	Q 8	900-3134	TSTR PNP 2N3134	599596
35	Q 9	900-1304	TSTR NPN 2N1304	599596
36	Q 10	900-1305	TSTR PNP 2N1305	599596
36	Q 11	900-1305	TSTR PNP 2N1305	599596
36	Q 12	900-1305	TSTR PNP 2N1305	599596
34	Q 13	7173	TSTR ASSY 2N673 MOD	599596
39	Q 14	900-2102	TSTR NPN 2N2102	599596
39	Q 15	900-2102	TSTR NPN 2N2102	599596
40	Q 16	900-3134	TSTR PNP 2N3134	599596
40	Q 17	900-3134	TSTR PNP 2N3134	599596
12	R 1	208-0271	RES FXD COMP 270 OHM	599596
13	R 2	208-0331	RES FXD COMP 330 OHM	599596
17	R 3	208-0560	RES FXD COMP 56 OHM	599596
19	R 4	208-0680	RES FXD COMP 68 OHM	599596
14	R 5	208-0332	RES FXD COMP 3X3K	599596
14	R 6	208-0332	RES FXD COMP 3X3K	599596
4	R 7	205-3161	RES FXD FILM 3X16K	599596
16	R 8	208-0473	RES FXD COMP 47K	599596
16	R 9	208-0473	RES FXD COMP 47K	599596
6	R 10	205-5621	RES FXD FILM 5X62K	599596
4	R 11	205-3161	RES FXD FILM 3X16K	599596
7	R 12	205-9093	RES FXD FILM 909K	599596
6	R 14	205-5621	RES FXD FILM 5X62K	599596
19	R 15	208-0680	RES FXD COMP 68 OHM	599596
19	R 16	208-0680	RES FXD COMP 68 OHM	599596
20	R 17	208-0681	RES FXD COMP 680 OHM	599596
24	R 18	211-1211	RES FXD FILM 1X21K	599596
5	R 19	205-3163	RES FXD FILM 316K	599596
15	R 20	208-0393	RES FXD COMP 39K	599596
9	R 21	208-0103	RES FXD COMP 10K	599596
18	R 22	208-0562	RES FXD COMP 5X6K	599596
9	R 23	208-0103	RES FXD COMP 10K	599596
8	R 24	208-0100	RES FXD COMP 10 OHM	599596
17	R 25	208-0560	RES FXD COMP 56 OHM	599596
11	R 26	208-0151	RES FXD COMP 150 OHM	599596
18	R 27	208-0562	RES FXD COMP 5X6K	599596
25	R 28	211-9091	RES FXD FILM 9X09K	599596
10	R 29	208-0104	RES FXD FILM 100K	599596
10	R 30	208-0104	RES FXD FILM L00K	599596
23	R 31	211-1102	RES FXD FILM 11X0K	599596
3	R 32	205-1504	RES FXD COMP 1X5M	599596
46	R 33	3598-0104	RES VAR 100K	599596
21	R 34	211-1001	RES FXD FILM 1X0K	599596
22	R 35	211-1003	RES FXD FILM 100K	599596
25	R 36	211-9091	RES FXD FILM 9X09K	599596
32	CR 1	801-0456	DIODE IN456A	599596
32	CR 2	801-0456	DIODE IN456A	599596
33	VR 1	801-0752	DIODE IN752A	599596
33	VR 2	801-0752	DIODE IN752A	599596

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
			ASSY TERMINAL BD	599597
1		173-0032	SCR BIND HD 2 56X1/2	599597
22		610-0742	TERMINAL	599597
23		617-0248	WASHER FLAT NO 2	599597
24		620-0121	WASHER IT NO 2	599597
25		649-0034	NUT 2 56	599597
40		21472-0003	INK MARKING	599597
43		599358	BOARD TERMINAL	599597
33	C 306	3335-0101	CAP 100 MFD 3V	599597
32	C 309	3317-9473	CAP X047 MFD 200V	599597
35	C 310	3564-0251	CAP 250 MFD 10V	599597
33	C 311	3335-0101	CAP 100 MFD 3V	599597
32	C 316	3317-9473	CAP X047 MFD 200V	599597
39	C 317	8918-0560	CAP 56 MFD 6V	599597
28	Q 316	900-1319	TSTR PNP 2N1319	599597
29	Q 317	900-1995	TSTR NPN 2N1995	599597
31	Q 318	900-3134	TSTR PNP 2N3134	599597
31	Q 319	900-3134	TSTR PNP 2N3134	599597
42	Q 320	599357	TSTR MATCHED W Q 321	599597
42	Q 321	599357	TSTR MATCHED W Q 320	599597
31	Q 322	900-3134	TSTR PNP 2N3134	599597
30	Q 323	900-2270	TSTR NPN 2N2270	599597
30	Q 324	900-2270	TSTR NPN 2N2270	599597
31	Q 325	900-3134	TSTR PNP 2N3134	599597
12	R 333	208-0152	RES FXD COMP 1X5K	599597
19	R 334	208-0560	RES FXD COMP 56 OHM	599597
15	R 335	208-0271	RES FXD COMP 270 OHM	599597
16	R 336	208-0331	RES FXD COMP 330 OHM	599597
17	R 337	208-0332	RES FXD COMP 3X3K	599597
17	R 338	208-0332	RES FXD COMP 3X3K	599597
17	R 339	208-0332	RES FXD COMP 3X3K	599597
7	R 340	205-5112	RES FXD FILM 51X1K	599597
6	R 341	205-2619	RES FXD FILM 26X1 OHM	599597
38	R 342	3580-0500	RES VAR 50 OHM	599597
6	R 343	205-2619	RES FXD FILM 26X1 OHM	599597
5	R 344	205-2151	RES FXD FILM 2X15K	599597
5	R 345	205-2151	RES FXD FILM 2X15K	599597
9	R 346	208-0101	RES FXD COMP 100 OHM	599597
3	R 347	205-1003	RES FXD FILM 100K	599597
3	R 348	205-1003	RES FXD FILM 100K	599597
7	R 350	205-5112	RES FXD FILM 51X1K	599597
10	R 351	208-0102	RES FXD COMP 1K	599597
20	R 352	208-0680	RES FXD COMP 68 OHM	599597
14	R 353	208-0181	RES FXD COMP 180 OHM	599597
8	R 354	205-6190	RES FXD FILM 619 OHM	599597
36	R 355	3575-0102	RES VAR 1K	599597
2	R 356	205-1001	RES FXD FILM 1X0K	599597
37	R 357	3575-0202	RES VAR 2K	599597
18	R 358	208-0392	RES FXD COMP 3X9K	599597
10	R 359	208-0102	RES FXD COMP 1K	599597
11	R 361	208-0103	RES FXD COMP 10K	599597
10	R 362	208-0102	RES FXD COMP 1K	599597
11	R 364	208-0103	RES FXD COMP 10K	599597
20	R 373	208-0680	RES FXD COMP 68 OHM	599597
4	R 374	205-1961	RES FXD FILM 1X96K	599597
21	R 375	208-0822	RES FXD COMP 8X2K	599597
13	R 376	208-0154	RES FXD COMP 150K	599597
26	CR 301	801-0096	DIODE 1N96A	599597
26	CR 302	801-0096	DIODE 1N96A	599597
41	CR 303	599239	DIODE	599597
34	CR 304	3432-0001	DIODE G129	599597
27	CR 305	801-0456	DIODE 1N456A	599597
27	CR 306	801-0456	DIODE 1N456A	599597
			ASSY	599599
1		705-0010	WIRE 22 AWG BLK	599599
2		705-0710	WIRE 22 AWG VIO	599599
3		706-0010	WIRE 26 AWG BLK	599599
4		706-0110	WIRE 26 AWG BRN	599599
5		706-0210	WIRE 26 AWG RED	599599
6		706-0310	WIRE 26 AWG ORN	599599
7		706-0410	WIRE 26 AWG YEL	599599
8		706-0510	WIRE 26 AWG GRN	599599
9		706-0610	WIRE 26 AWG BLUE	599599
10		706-0710	WIRE 26 AWG VIO	599599
11		706-0810	WIRE 26 AWG GRAY	599599
12		706-0900	WIRE 26 AWG WH/BLK	599599
13		706-0901	WIRE 26 AWG WH/BRN	599599
14		706-0902	WIRE 26 AWG WH/RED	599599
15		706-0903	WIRE 26 AWG WH/ORN	599599

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
16		706-0904	WIRE 26 AWG WH/YEL	599599
17		706-0905	WIRE 26 AWG WH/GRN	599599
18		706-0906	WIRE 26 AWG WH/BLUE	599599
19		706-0907	WIRE 26 AWG WH/VIO	599599
20		706-0908	WIRE 26 AWG WH/GRAY	599599
21		706-0910	WIRE 26 AWG WH	599599
23		3389-0011	CORD LACING	599599
25		3486-0001	LUG SOLDER NO 4	599599
0	A 1		ASSY WIRING HARNESS	599599
22	J 1	3318-5016	CONN 22 PIN	599599
22	J 2	3318-5016	CONN 22 PIN	599599
22	J 3	3318-5016	CONN 22 PIN	599599
22	J 4	3318-5016	CONN 22 PIN	599599
24	P 1	3394-0003	CONN 16P	599599
			FNL ASSY 599H VLF RCV	599621
7	A 1	599378	ASSY CHASSIS	599621
20	A 2	599623	ASSY CONN PANEL	599621
21	A 3	599624	ASSY RCVR/SYN MODULE	599621
22	A 4	599626	ASSY AGC/PHASE MODULE	599621
10	A 5	599394	ASSY PHASE SERVO MOD	599621
23	A 6	599723	ASSY POWER SUPPLY MOD	599621
25	A 7	599811	ASSY ACCESSORY PARTS	599621
1	FL 1	599175-0000	RF FILTER SELECT FREQ	599621
1	FL 2	599175-0000	RF FILTER SELECT FREQ	599621
1	FL 3	599175-0000	RF FILTER SELECT FREQ	599621
1	FL 4	599175-0000	RF FILTER SELECT FREQ	599621
			ASSY CONN PANEL 599 H	599623
1		90-0142	TERMINAL INSULATED	599623
2		175-0024	SCR BIND HD 4 40X3/8	599623
3		175-0032	SCR BIND HD 4 40X1/2	599623
4		177-0020	SCR BIND HD 6 32X5/16	599623
5		177-0032	SCR BIND HD 6 32X1/2	599623
6		177-0040	SCR BIND HD 6 32X5/8	599623
10		242-0024	SCR FIL HD 6 32X3/8	599623
11		617-0267	WASHER FLAT NO 6	599623
12		620-0123	WASHER LOCK INT NO 4	599623
13		620-0125	WASHER LOCK INT NO 6	599623
14		621-0125	WASHER LOCK INT 3/8	599623
15		649-0074	NUT 4 40	599623
16		649-0114	NUT 6 32	599623
17		653-0016	WASHER FLAT 3/8	599623
22		3326-0042	RIVET POP	599623
23		3326-0043	RIVET POP	599623
24		3326-0132	RIVET POP	599623
25		3331-0031	NUT CLINCH 6 32	599623
27		3428-0002	MTG KIT TSTR	599623
28		3459-0003	CONN PLUG POWER	599623
29		3486-0005	LUG SOLDER NO 6	599623
30		3486-0027	LUG SOLDER 3/8	599623
32		3560-0002	NUT LOCKING	599623
37		3803-0024	PLUG SNAP	599623
38		5606-0116	STANDOFF 6 32X1X25	599623
39		6152	PLATE IDENTIFICATION	599623
40		599023	BRKT CONN PANEL	599623
41		599024	PANEL CONN INTERNAL	599623
42		599059	COVER COMP	599623
43		599079	BUSS GROUND INTERNAL	599623
44		599102	PIN GUIDE ROUND	599623
45		599106	STANDOFF	599623
46		599312	BUSS GROUND EXTERNAL	599623
47		599314	INSULATOR ANT INPUT	599623
48		599361	PIN GUIDE RECT	599623
49		599369-0002	PANEL CONN EXTERNAL	599623
51		599397	SHELL PROTECTIVE	599623
50	A 1	599380	ASSY HARNESS	599623
21	C 1	3321-9102	CAP CER DISC X1 MFD	599623
26	J 6	3391	CONN COAXIAL	599623
26	J 8	3391	CONN COAXIAL	599623
26	J 9	3391	CONN COAXIAL	599623
26	J 10	3391	CONN COAXIAL	599623
26	J 11	3391	CONN COAXIAL	599623
26	J 12	3391	CONN COAXIAL	599623
26	J 13	3391	CONN COAXIAL	599623
26	J 15	3391	CONN COAXIAL	599623
19	Q 1	900-3055	TSTR NPN 2N3055	599623
18	Q 2	900-1363	TSTR PNP 2N1363	599623
9	R 1	214-9301	RES FXD WW 3 OHM 3W	599623
9	R 2	214-9301	RES FXD WW 3 OHM 3W	599623
7	R 3	208-0102	RES FXD COMP 1K 1/2W	599623

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
7	R 4	208-0102	RES FXD COMP 1K 1/2W	599623
7	R 5	208-0102	RES FXD COMP 1K 1/2W	599623
8	R 6	208-0821	RES FXD COMP 820 OHM	599623
31	R 7	3522-0502	RES VAR 5K 2W	599623
31	R 8	3522-0502	RES VAR 5K 2W	599623
31	R 9	3522-0502	RES VAR 5K 2W	599623
36	R 10	3654-9101	RES FXD WW 1 OHM 1W	599623
34	S 1	3633-0001	SWITCH SLIDE	599623
33	S 2	3573-0001	SWITCH PUSH BUTTON	599623
33	S 3	3573-0001	SWITCH PUSH BUTTON	599623
35	S 4	3641-0002	SWITCH SLIDE	599623
20	TB 1	3311-0553	TERMINAL STRIP	599623
			ASSY RECEIVER MODULE	599624
1		175-0020	SCR BIND HD 4 40X5/16	599624
3		175-0032	SCR BIND HD 4 40X1/2	599624
4		175-0040	SCR BIND HD 4 40X5/8	599624
5		177-0016	SCR BIND HD 6 32X/4	599624
6		177-0020	SCR BIND HD 6 32X5/16	599624
7		218-0020	SCR FH 4 40X5/16	599624
8		218-0048	SCR FH 4 40X3/4	599624
9		365-0024	SCR HEX HD 4 40X3/8	599624
10		399-0024	SCR HEX SOC 4 40X3/8	599624
13		617-0256	WASHER FLAT NO 4	599624
14		617-0267	WASHER FLAT NO 6	599624
15		620-0123	WASHER IT LOCK NO 4	599624
16		620-0125	WASHER IT LOCK NO 6	599624
17		621-0121	WASHER IT LOCK 1/4	599624
18		639-0006	WASHER NYLON NO 4	599624
19		649-0074	NUT 4 40	599624
20		649-0114	NUT 6 32	599624
21		3326-0032	RIVET POP	599624
22		3326-0042	RIVET POP	599624
23		3326-0043	RIVET POP	599624
24		3326-0045	RIVET POP	599624
25		3326-0046	RIVET POP	599624
26		3331-0032	NUT CLINCH 6 32	599624
27		3455-0772	CLAMP CABLE	599624
42		3805-0011	SPADE BOLT 6 32	599624
43		3807-0022	RUBBER 1/2X7/16 THICK	599624
44		4750-0016	SPACER NO 6 1/4 DIA	599624
45		5586-0036	STANDOFF 4 40X9/16	599624
46		5586-0048	STANDOFF 4 40X3/4	599624
47		5586-0108	STANDOFF 4 40X1 1/8	599624
48		5586-0124	STANDOFF 4 40X1 13/8	599624
49		5586-0200	STANDOFF 4 40X2	599624
50		6152	PLATE IDENTIFICATION	599624
52		599203	PANEL FRONT	599624
53		599209	COVER MODULE	599624
54		599210	COVER ACCESS	599624
55		599211	SHIELD CHASSIS BRACE	599624
56		599213	SUPPORT CHASSIS	599624
57		599217	BRKT RECORDER INT	599624
58		599249	GUIDE BOARD	599624
60		599253-0110	SPACER NO 4 3/16 DIA	599624
61		599268	CHASSIS BOTTOM	599624
62		599270	PANEL REAR	599624
63		599271	CHASSIS PCB	599624
64		599272	CHASSIS SUB FRONT	599624
65		599273-2925	STANDOFF	599624
66		599274	BAR CHASSIS	599624
67		599284	SPACER ACTUATOR	599624
70		599370	CLAMP	599624
71		599409	PLATE ESCUTCHEON	599624
75		599564	SHIELD PCB	599624
86		599663	PLATE CHART INST	599624
87		599664	PLATE RECORDER DATA	599624
88		599667	BEARING PANEL	599624
89		3807-0001	RUBBER STRIP	599624
68	A 1	599287-0001	RECORDER	599624
77	A 2	599589	ASSY PCB PRESET CON	599624
78	A 3	599590	ASSY PCB VCO/CON LP 1	599624
79	A 4	599591	ASSY PCB CON LOOP 2	599624
80	A 5	599592	ASSY PCB LIM/FREQ DIV	599624
76	A 6	599568	ASSY PCB RECEIVER	599624
81	A 7	599593	ASSY PCB COARSE TUNE	599624
82	A 8	599594	ASSY PCB BB FILT ETC	599624
83	A 9	599595	ASSY PCB ATTENUATOR	599624
74	A 10	599552	ASSY PCB AUDIO AMPL	599624
85	A 11	599625	ASSY WIRING HARNESS	599624
84	A 12	599599	ASSY WIRING HARNESS	599624
28	E 1	3458-0001	KNOB ROUND	599624
29	E 2	3458-0094	KNOB POINTER	599624

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
29	E 3	3458-0094	KNOB POINTER	599624
32	H 1	3475-0001	SCREW CAPTIVE 6 32	599624
33	R 25	3523-0502	RES VAR 5K 2W	599624
34	R 26	3608-0502	RES VAR 5K 1/2W	599624
37	S 1	3643	SWITCH	599624
38	S 2	3644	SWITCH ROTARY	599624
36	S 3	3640-0004	SWITCH TOGGLE	599624
69	S 4	599288	SWITCH THUMBWHEEL	599624
51	FL 5	599177	FILTER IF BANDPASS	599624
41	LS 1	3649-0005	LOUDSPEAKER 3X2 OHM	599624
31	MP 1	3473-0001	COUPLING SHAFT	599624
12	MP 2	612-0003	HANDLE	599624
11	MP 3	611-0053	FERRULE	599624
30	MP 4	3472-0001	SHAFT LOCK	599624
40	XA 1	3648-0008	CONN 6 PIN	599624
39	XS 4	3647-0302	CONN 10 PIN	599624
39	XS 4	3647-0302	CONN 10 PIN	599624
39	XS 4	3647-0302	CONN 10 PIN	599624
35	XFL 1	3634-0001	SOCKET	599624
35	XFL 2	3634-0001	SOCKET	599624
35	XFL 3	3634-0001	SOCKET	599624
35	XFL 4	3634-0001	SOCKET	599624
			ASSY	599625
1		706-0010	WIRE 26AWG BLK	599625
2		706-0110	WIRE 26AWG BRN	599625
3		706-0210	WIRE 26AWG RED	599625
4		706-0310	WIRE 26AWG ORN	599625
5		706-0410	WIRE 26AWG YEL	599625
6		706-0510	WIRE 26AWG GRN	599625
7		706-0610	WIRE 26AWG BLUE	599625
8		706-0710	WIRE 26AWG VIO	599625
9		706-0810	WIRE 26AWG GREY	599625
10		706-0900	WIRE 26AWG WHT/BLK	599625
11		706-0901	WIRE 26AWG WHT/BRN	599625
12		706-0902	WIRE 26AWG WHT/RED	599625
13		706-0903	WIRE 26AWG WHT/ORN	599625
14		706-0904	WIRE 26AWG WHT/YEL	599625
15		706-0905	WIRE 26AWG WHT/GRN	599625
16		706-0906	WIRE 26AWG WHT/BLUE	599625
17		706-0907	WIRE 26AWG WHT/VIO	599625
18		706-0908	WIRE 26AWG WHT/GREY	599625
19		706-0910	WIRE 26AWG WHT	599625
0	A 1		ASSY WIRING HARNESS	599625
20	J 5	3318-5016	CONN 22 PIN	599625
20	J 6	3318-5016	CONN 22 PIN	599625
21	P 2	3394-0003	CONN 16 PIN	599625
			ASSY AGC/PHASE MODULE	599626
3		175-0016	SCR BIND HD 4 40X1/4	599626
4		175-0020	SCR BIND HD 4 40X5/16	599626
5		175-0032	SCR BIND HD 4 40X1/2	599626
6		177-0016	SCR BIND HD 6 32X1/4	599626
7		177-0020	SCR BIND HD 6 32X5/16	599626
9		365-0024	SCR HEX HD 4 40X3/8	599626
10		561-0024	SCR HEX SOC 6 32X3/8	599626
11		611-0053	FERRULES	599626
12		612-0003	HANDLE	599626
13		617-0256	WASHER FLAT NO 4	599626
14		617-0267	WASHER FLAT NO 6	599626
15		620-0123	WASHER LOCK IT N04	599626
16		620-0125	WASHER LOCK IT N06	599626
17		639-0006	WASHER NYLON N04	599626
18		649-0074	NUT 4 40	599626
19		649-0114	NUT 6 32	599626
21		3326-0032	RIVET POP	599626
22		3326-0042	RIVET POP	599626
23		3331-0022	NUT CLINCH 4 40	599626
24		3331-0037	NUT CLINCH 6 32	599626
25		3429	MTG KIT TSTR	599626
28		3455-0773	CLAMP CABLE	599626
31		3475-0001	SCR CAP 6 32	599626
34		5057-0032	STANDOFF 4 40X1/2	599626
35		5067-0048	STANDOFF 6 32X3/4	599626
36		6152	PLATE IDENTIFICATION	599626
37		21472-0003	INK MARKING	599626
38		8145	CHANNEL BOTTOM	599626
39		599028	RAIL TOP	599626
40		599029	RAIL BOTTOM	599626
41		599034	BRKT COMP MTG	599626
42		599038	COVER	599626

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
43		599077	HEATSINK	599626
44		599105	BRKT CAP MTG	599626
47		599356	PANEL REAR BLACK	599626
48		599456	PANEL FRONT	599626
52		599788	BOARD PRINTED CIRCUIT	599626
53	A 1	599797	ASSY WIRING HARNESS	599626
51	A 2	599597	ASSY TERMINAL BOARD	599626
50	A 3	599596	ASSY PCB	599626
32	C 302	3482-0001	CAP 1000/1000 MFD	599626
32	C 307	3482-0001	CAP 1000/1000 MFD	599626
29	K 301	3468-1103	RELAY	599626
45	M 301	599109	METER	599626
49	M 302	599483	METER	599626
20	Q 1	7173	TSTR ASSY 2N673 MOD	599626
20	Q 2	7173	TSTR ASSY 2N673 MOD	599626
20	Q 314	7173	TSTR ASSY 2N673 MOD	599626
20	Q 315	7173	TSTR ASSY 2N673 MOD	599626
33	R 13	3583-0103	RES VAR 10K	599626
8	R 360	200-0392	RESISTOR 3X9K 1/4W	599626
46	T 301	599180	TRANSFORMER	599626
1	DS 301	87-0321	LAMP MINAT	599626
2	DS 302	87-0364	LAMP MINAT	599626
30	XK 301	3469-0001	SOCKET RELAY	599626
27	XDS 301	3440-2900	HOLDER INDICATOR LAMP	599626
26	XDS 302	3440-2200	HOLDER INDICATOR LAMP	599626
			ASSY PCB POWER SUPPLY	599721
1		82	PAD MTG TSTR	599721
26		3657-0013	PAD MTG TSTR	599721
28		3878-0001	HEATSINK TO 5	599721
30		599720	BOARD PRINTED CIRCUIT	599721
29	C 1	8916-0121	CAPACITOR 120 MFD	599721
29	C 2	8916-0121	CAPACITOR 120 MFD	599721
25	C 3	3340-0100	CAPACITOR 10 MFD	599721
23	C 4	3324-9104	CAPACITOR X001 MFD	599721
24	C 5	3324-9224	CAPACITOR X0022 MFD	599721
22	Q 3	900-3708	TSTR 2N3708	599721
22	Q 4	900-3708	TSTR 2N3708	599721
20	Q 5	900-3702	TSTR 2N3702	599721
20	Q 6	900-3702	TSTR 2N3702	599721
21	Q 7	900-3705	TSTR 2N3705	599721
19	Q 8	900-3134	TSTR 2N3134	599721
18	Q 9	900-2270	TSTR 2N2270	599721
27	R 3	3838-0101	RESISTOR VARIABLE	599721
2	R 4	205-9090	RESISTOR 909 OHM 1/2W	599721
3	R 5	208-0101	RESISTOR 100 OHM 1/2W	599721
6	R 6	208-0152	RESISTOR 1X5K 1/2W	599721
2	R 7	205-9090	RESISTOR 909 OHM 1/2W	599721
2	R 8	205-9090	RESISTOR 909 OHM 1/2W	599721
6	R 9	208-0152	RESISTOR 1X5K 1/2W	599721
13	R 10	209-0101	RESISTOR 100 OHM 1W	599721
10	R 11	208-0332	RESISTOR 3X3K 1/2W	599721
7	R 12	208-0222	RESISTOR 2X2K 1/2W	599721
12	R 13	208-0821	RESISTOR 820 OHM 1/2W	599721
8	R 14	208-0271	RESISTOR 270 OHM 1/2W	599721
5	R 15	208-0120	RESISTOR 12 OHM 1/2W	599721
4	R 16	208-0102	RESISTOR 1K 1/2W	599721
14	R 17	210-0101	RESISTOR 100 OHM 2W	599721
11	R 18	208-0471	RESISTOR 470 OHM 1/2W	599721
9	R 19	208-0331	RESISTOR 330 OHM 1/2W	599721
4	R 20	208-0102	RESISTOR 1K 1/2W	599721
3	R 21	208-0101	RESISTOR 100 OHM 1/2W	599721
15	CR 1	800-4002	DIODE 1N4002	599721
15	CR 2	800-4002	DIODE 1N4002	599721
15	CR 3	800-4002	DIODE 1N4002	599721
15	CR 4	800-4002	DIODE 1N4002	599721
15	CR 5	800-4002	DIODE 1N4002	599721
15	CR 6	800-4002	DIODE 1N4002	599721
15	CR 7	800-4002	DIODE 1N4002	599721
15	CR 8	800-4002	DIODE 1N4002	599721
17	VR 1	801-0753	DIODE ZENER 1N753A	599721
16	VR 2	801-0746	DIODE ZENER 1N746A	599721
			WIRING HARNESS ASSY	599722
1		703-0010	1N WIRE 18 AWG BLK	599722
2		703-0110	1N WIRE 18 AWG BRN	599722
3		703-0210	1N WIRE 18 AWG RED	599722
4		703-0310	1N WIRE 18 AWG ORN	599722
5		703-0410	1N WIRE 18 AWG YEL	599722
6		703-0510	1N WIRE 18 AWG GRN	599722
7		703-0610	1N WIRE 18 AWG BLUE	599722

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
8		703-0710	1N WIRE 18 AWG V10	599722
9		703-0810	1N WIRE 18 AWG GRAY	599722
10		703-0900	1N WIRE 18 AWG WHT/BL	599722
11		703-0905	1N WIRE 18 AWG WHT/GR	599722
12		703-0908	1N WIRE 18 AWG WHT/GR	599722
13		703-0910	1N WIRE 18 AWG WHT	599722
14		705-0010	1N WIRE 22 AWG BLK	599722
15		705-0210	1N WIRE 22 AWG RED	599722
16		705-0510	1N WIRE 22 AWG GRN	599722
17		705-0902	1N WIRE 22 AWG WHT/RE	599722
18		705-0905	1N WIRE 22 AWG WHT/GR	599722
19		705-0906	1N WIRE 22 AWG WHT/BL	599722
20		3389-0011	CORD LACING	599722
24		8819-0018	1N WIRE 18 AWG BUS	599722
25	C 9	8914-0101	CAP 100 MFD 20 V	599722
25	C 10	8914-0101	CAP 100 MFD 20 V	599722
22	E 1	3486-0001	LUG SOLDER NO 4	599722
23	J 1	3628-0022	CONN 22 PIN	599722
21	P 2	3394-0004	CONN 24P	599722
			ASSY POWER SUPPLY	599723
2		175-0016	SCR BIND HD 4 40X1/4	599723
3		175-0020	SCR BIND HD 4 40X5/16	599723
4		175-0024	SCR BIND HD 4 40X3/8	599723
5		175-0032	SCR BIND HD 4 40X1/2	599723
6		177-0016	SCR BIND HD 6 32X1/4	599723
7		177-0020	SCR BIND HD 6 32X5/16	599723
8		365-0024	SCREW HEX HD 4 40X3/8	599723
9		561-0024	SCR HEX SOC 6 32X3/8	599723
10		611-0053	FERRULES	599723
11		612-0003	HANDLE	599723
12		617-0256	WASHER FLAT NO 4	599723
13		617-0267	WASHER FLAT NO 6	599723
14		620-0123	WASHER LOCK IT NO 4	599723
15		620-0125	WASHER LOCK IT NO 6	599723
16		620-0126	WASHER LOCK IT NO 8	599723
17		639-0006	WASHER NYLON NO 4	599723
18		649-0074	NUT 4 40	599723
19		649-0114	NUT 6 32	599723
20		649-0134	NUT 8 32	599723
21		3326-0042	RIVET POP	599723
22		3331-0022	NUT CLINCH 4 40	599723
23		3331-0032	NUT CLINCH 6 32	599723
29		3455-0773	CLAMP CABLE	599723
30		3475-0001	SCREW CAPTIVE 6 32	599723
36		5057-0032	STANDOFF 4 40X1/2	599723
37		5067-0100	STANDOFF 6 32X1	599723
39		8145	CHANNEL BOTTOM	599723
40		599028	RAIL TOP	599723
41		599033	BRKT COMP MTG	599723
42		599038	COVER	599723
43		599060	BRKT CAP MTG	599723
46		599724	PANEL REAR GOLD	599723
47		599725	PANEL PAINTED FRONT	599723
45	A 1	599722	ASSY WIRING HARNESS	599723
44	A 2	599721	ASSY PCB	599723
31	C 6	3481-0014	CAP 1000 MFD 50V	599723
31	C 7	3481-0014	CAP 1000 MFD 50V	599723
26	C 8	3408-9502	CAP X5 MFD	599723
25	F 1	3346-9501	FUSE 5A FAST ACTING	599723
24	F 2	3346-9201	FUSE 2A FAST ACTING	599723
32	F 3	3487-9252	FUSE 1/4A SLO BLOW	599723
32	F 4	3487-9252	FUSE 1/4A SLO BLOW	599723
35	S 1	3490-0002	SWITCH DPST	599723
35	S 2	3490-0002	SWITCH DPST	599723
38	T 1	9008	TRANSFORMER	599723
1	DS 1	87-0364	LAMP MINAT NO 1829	599723
1	DS 2	87-0364	LAMP MINAT NO 1829	599723
34	XF 1	3489-0002	HOLDER FUSE	599723
34	XF 2	3489-0002	HOLDER FUSE	599723
33	XF 3	3488-0002	HOLDER FUSE	599723
33	XF 4	3488-0002	HOLDER FUSE	599723
28	XDS 1	3440-2500	HOLDER INDICATOR LAMP	599723
27	XDS 2	3440-2200	HOLDER INDICATOR LAMP	599723
			ASSY WIRING HARNESS	599797
1		703-0010	WIRE 18AWG BLK	599797
2		703-0210	WIRE 18AWG RED	599797
3		703-0410	WIRE 18AWG YEL	599797
4		705-0010	WIRE 22AWG BLK	599797
5		705-0110	WIRE 22AWG BRN	599797

ITEM NUMBER	REFERENCE DESIGNATION	T R A C O R STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
6		705-0210	WIRE 22AWG RED	599797
7		705-0310	WIRE 22AWG ORN	599797
8		705-0410	WIRE 22AWG YEL	599797
9		705-0510	WIRE 22AWG GRN	599797
10		705-0610	WIRE 22AWG BLUE	599797
11		705-0710	WIRE 22AWG VIO	599797
12		705-0810	WIRE 22AWG GREY	599797
13		705-0900	WIRE 22AWG WHT/BLK	599797
14		705-0901	WIRE 22AWG WHT/BRN	599797
15		705-0902	WIRE 22AWG WHT/RED	599797
16		705-0903	WIRE 22AWG WHT/ORN	599797
17		705-0904	WIRE 22AWG WHT/YEL	599797
18		705-0905	WIRE 22AWG WHT/GRN	599797
19		705-0906	WIRE 22AWG WHT/BLUE	599797
20		705-0907	WIRE 22AWG WHT/VIO	599797
21		705-0908	WIRE 22AWG WHT/GREY	599797
22		705-0910	WIRE 22AWG WHT	599797
23		706-0010	WIRE 26AWG BLK	599797
24		706-0110	WIRE 26AWG BRN	599797
25		706-0310	WIRE 26AWG ORN	599797
26		706-0410	WIRE 26AWG YEL	599797
27		706-0510	WIRE 26AWG GRN	599797
28		706-0610	WIRE 26AWG BLUE	599797
29		706-0810	WIRE 26AWG GREY	599797
30		706-0902	WIRE 26AWG WHT/RED	599797
31		706-0908	WIRE 26AWG WHT/GREY	599797
32		706-0910	WIRE 26AWG WHT	599797
33		3388-0116	CABLE COAX RG/174U	599797
34		3389-0011	CORD LACING	599797
36		3486-0001	LUG SOLDER NO 4	599797
37		3486-0009	LUG SOLDER NO 8	599797
38	J 302	3628-0015	CONNECTOR	599797
35	P 301	3394-0004	CONN 24P	599797
			ASSY ACCESSORY PARTS	599811
1		87-0321	LAMP 2V	599811
2		87-0364	LAMP 28V	599811
3		3346-9201	FUSE 2 AMP	599811
4		3346-9501	FUSE 5 AMP	599811
8		3487-9252	FUSE 1/4 AMP	599811
15		599665	MANUAL CHART RECORDER	599811
17		599806	MANUAL OPS SERVICE	599811
13	A 1	599282	ASSY 16 PIN CABLE	599811
14	A 2	599283	ASSY 24 PIN CABLE	599811
12	A 3	599266	ASSY 22 PIN PCB EXT	599811
11	A 4	599168	ASSY ANTENNA CABLE	599811
7	W 1	3467-0016	CORD EXTENSION	599811
9	CP 1	3559-0002	ADAPTER GROUNDING	599811
6	MP 1	3392-0011	CONN 16 PIN	599811
5	MP 2	3390	CONN PLUG	599811
10	MP 3	3650-0001	PAPER CHART ROLL	599811
16	MP 4	599666	SCALE CHART	599811
5	MP 5	3390	CONN PLUG	599811
			PCB ASSY AGC JUMPER	599849
2		599788	BOARD PC	599849
3	R 360	200-0392	RES 3X9K	599849

TRACOR STOCK NUMBER	DESCRIPTION	MANUFACTURER CODE NUMBER	MANUFACTURER PART NUMBER	TOTAL QUANTITY
82	MOUNT TSTR	17069	88000	206.
87-0321	LAMP BULB NO 49	08806	49	2.
87-0364	LAMP BULB NO 1829	08806	1829	5.
90-0142	TERMINAL INS	71729	4267-1	9.
94-0025	TUBING 3/32 BLACK	70331	FIT-221-3/32 BLACK	56.
95-0003	TUBING NO 20 CLEAR	70331	PVC-105-20 CLEAR	REF
95-0025	TUBING 3/8 CLEAR	70331	PVC-105/3/8 CLEAR (MIL-I-631)	108.
173-0032	SCR BND HD 2 56X1/2L	73734	4006	6.
175-0016	SCR BND HD 4 40X1/4L	73734	4022	6.
175-0020	SCR BND HD 4 40X5/16L	73734	4023	56.
175-0024	SCR BND HD 4 40X3/8L	73734	4024	4.
175-0032	SCR BND HD 4 40X1/2	73734	4026	26.
175-0040	SCR BND HD 4 40X5/8L	73734	4027	3.
177-0016	SCR BND HD 6 32X1/4L	73734	4032	52.
177-0020	SCR BND HD 6 32X5/16L	73734	4033	75.
177-0032	SCR BND HD 6 32X1/2L	73734	4036	4.
177-0040	SCR BND HD 6 32X5/8L	73734	4037	2.
200-0100	RES FXD COMP 10 OHM	01121	RC07GF100K (MIL-R-11/8D)	17.
200-0101	RES FXD COMP 100 OHM	01121	RC07GF101K (MIL-R-11/8D)	36.
200-0102	RES FXD COMP 1X0K	01121	RC07GF102K (MIL-R-11/8D)	40.
200-0103	RES FXD COMP 10K	01121	RC07GF103K (MIL-R-11/8D)	25.
200-0104	RES FXD COMP 100K	01121	RC07GF104K (MIL-R-11/8D)	3.
200-0105	RES FXD COMP 1X0M	01121	RC07GF105K (MIL-R-11/8D)	2.
200-0122	RES FXD COMP 1X2K	01121	RC07GF122K (MIL-R-11/8D)	9.
200-0123	RES FXD COMP 12K	01121	RC07GF123K (MIL-R-11/8D)	1.
200-0124	RES FXD COMP 120K	01121	RC07GF124K (MIL-R-11/8D)	2.
200-0125	RES FXD COMP 1.2 M	01121	RC07GF125K (MIL-R-11/8D)	1.
200-0151	RES FXD COMP 150 OHM	01121	RC07GF151K (MIL-R-11/8D)	3.
200-0152	RES FXD COMP 1X5K	01121	RC07GF152K (MIL-R-11/8D)	9.
200-0153	RES FXD COMP 15K	01121	RC07GF153K (MIL-R-11/8D)	5.
200-0181	RES FXD COMP 180 OHM	01121	RC07GF181K (MIL-R-11/8D)	3.
200-0182	RES FXD COMP 1X8K	01121	RC07GF182K (MIL-R-11/8D)	17.
200-0183	RES FXD COMP 18K	01121	RC07GF183K (MIL-R-11/8D)	4.
200-0220	RES FXD COMP 22 OHM	01121	RC07GF220K (MIL-R-11/8D)	1.
200-0221	RES FXD COMP 220 OHM	01121	RC07GF221K (MIL-R-11/8D)	12.
200-0222	RES FXD COMP 2X2K	01121	RC07GF222K (MIL-R-11/8D)	14.
200-0223	RES FXD COMP 22K	01121	RC07GF223K (MIL-R-11/8D)	18.
200-0224	RES FXD COMP 220K	01121	RC07GF224K (MIL-R-11/8D)	2.
200-0271	RES FXD COMP 270 OHM	01121	RC07GF271K (MIL-R-11/8D)	4.
200-0272	RES FXD COMP 2X7K	01121	RC07GF272K (MIL-R-11/8D)	14.
200-0273	RES FXD COMP 27K	01121	RC07GF273K (MIL-R-11/8D)	14.
200-0330	RES FXD COMP 33 OHM	01121	RC07GF330K (MIL-R-11/8D)	1.
200-0331	RES FXD COMP 330 OHM	01121	RC07GF331K (MIL-R-11/8D)	6.
200-0332	RES FXD COMP 3X3K	01121	RC07GF332K (MIL-R-11/8D)	13.
200-0333	RES FXD COMP 33K	01121	RC07GF333K (MIL-R-11/8D)	11.
200-0391	RES FXD COMP 390 OHM	01121	RC07GF391K (MIL-R-11/8D)	17.
200-0392	RES FXD COMP 3X9K	01121	RC07GF392K (MIL-R-11/8D)	29.
200-0393	RES FXD COMP 39K	01121	RC07GF393K (MIL-R-11/8D)	2.
200-0470	RES FXD COMP 47 OHM	01121	RC07GF470K (MIL-R-11/8D)	6.
200-0471	RES FXD COMP 470 OHM	01121	RC07GF471K (MIL-R-11/8D)	13.
200-0472	RES FXD COMP 4X7K	01121	RC07GF472K (MIL-R-11/8D)	14.
200-0473	RES FXD COMP 47K	01121	RC07GF473K (MIL-R-11/8D)	2.
200-0475	RES FXD COMP 4X7M	01121	RC07GF475K (MIL-R-11/8D)	1.
200-0560	RES FXD COMP 56 OHM	01121	RC07GF560K (MIL-R-11/8D)	5.
200-0561	RES FXD COMP 560 OHM	01121	RC07GF561K (MIL-R-11/8D)	10.
200-0562	RES FXD COMP 5X6K	01121	RC07GF562K (MIL-R-11/8D)	29.
200-0563	RES FXD COMP 56K	01121	RC07GF563K (MIL-R-11/8D)	1.
200-0564	RES FXD COMP 560K	01121	RC07GF564K (MIL-R-11/8D)	2.
200-0681	RES FXD COMP 680 OHM	01121	RC07GF681K (MIL-R-11/8D)	3.
200-0682	RES FXD COMP 6X8K	01121	RC07GF682K (MIL-R-11/8D)	12.
200-0683	RES FXD COMP 68K	01121	RC07GF683K (MIL-R-11/8D)	3.
200-0821	RES FXD COMP 820 OHM	01121	RC07GF821K (MIL-R-11/8D)	18.
200-0822	RES FXD COMP 8X2K	01121	RC07GF822K (MIL-R-11/8D)	23.
200-0823	RES FXD COMP 82K	01121	RC07GF823K (MIL-R-11/8D)	5.
204-0151	RES FXD COMP 150 OHM	01121	RC07GF151J (MIL-R-11/8D)	1.
204-0221	RES FXD COMP 220 OHM	01121	RC07GF221J (MIL-R-11/8D)	8.
204-0331	RES FXD COMP 330 OHM	01121	RC07GF331J (MIL-R-11/8D)	8.
204-0511	RES FXD COMP 510 OHM	01121	RC07GF511J (MIL-R-11/8D)	1.
204-0681	RES FXD COMP 680 OHM	01121	RC07GF681J (MIL-R-11/8D)	1.
204-0821	RES FXD COMP 820 OHM	01121	RC07GF821J (MIL-R-11/8D)	1.
205-1001	RES FXD FILM 1K	79727	RN65D1001F (MIL-R-10509/2)	1.
205-1002	RES FXD FILM 10K	79727	RN65D1002F (MIL-R-10509/2)	2.
205-1003	RES FXD FILM 100K	79727	RN65D1003F (MIL-R-10509/2)	2.
205-1102	RES FXD FILM 11X0K	79727	RN65D1102F (MIL-R-10509/2)	4.
205-1181	RES FXD FILM 1X18K	79727	RN65D1181F (MIL-R-10509/2)	3.
205-1211	RES FXD FILM 1X21K	79727	RN65D1211F (MIL-R-10509/2)	2.
205-1212	RES FXD FILM 12X1K	79727	RN65D1212F (MIL-R-10509/2)	2.
205-1331	RES FXD FILM 1X33K	79727	RN65D1331F (MIL-R-10509/2)	1.
205-1402	RES FXD FILM 14X0K	79727	RN65D1402F (MIL-R-10509/2)	1.
205-1471	RES FXD FILM 1X47K	79727	RN65D1471F (MIL-R-10509/2)	1.
205-1472	RES FXD FILM 14X7K	79727	RN65D1472F (MIL-R-10509/2)	1.
205-1473	RES FXD FILM 147K	79727	RN65D1473F (MIL-R-10509/2)	1.
205-1503	RES FXD FILM 150K	79727	RN65D1503F (MIL-R-10509/2)	1.
205-1504	RES FXD FILM 1X50M	79727	RN65D1504F (MIL-R-10509/2)	2.
205-1542	RES FXD FILM 15X4K	79727	RN65D1542F (MIL-R-10509/2)	3.

TRACOR STOCK NUMBER	DESCRIPTION	MANUFACTURER CODE NUMBER	MANUFACTURER PART NUMBER	TOTAL QUANTITY
205-1621	RES FXD FILM 1X62K	79727	RN65D1621F (MIL-R-10509/2)	2.
205-1622	RES FXD FILM 16X2K	79727	RN65D1622F (MIL-R-10509/2)	1.
205-1743	RES FXD FILM 174 K	79727	RN65D1743F (MIL-R-10509/2)	2.
205-1781	RES FXD FILM 1X78K	79727	RN65D1781F (MIL-R-10509/2)	3.
205-1782	RES FXD FILM 17X8K	79727	RN65D1782F (MIL-R-10509/2)	1.
205-1961	RES FXD FILM 1X96K	79727	RN65D1961F (MIL-R-10509/2)	1.
205-1962	RES FXD FILM 19X6K	79727	RN65D1962F (MIL-R-10509/2)	1.
205-2000	RES FXD FILM 200 OHM	79727	RN65D2000F (MIL-R-10509/2)	1.
205-2052	RES FXD FILM 20X5K	79727	RN65D2052F (MIL-R-10509/2)	1.
205-2151	RES FXD FILM 2X15K	79727	RN65D2151F (MIL-R-10509/2)	6.
205-2370	RES FXD FILM 237 OHM	79727	RN65D2370F (MIL-R-10509/2)	10.
205-2372	RES FXD FILM 23X7K	79727	RN65D2372F (MIL-R-10509/2)	2.
205-2373	RES FXD FILM 237K	79727	RN65D2373F (MIL-R-10509/2)	1.
205-2430	RES FXD FILM 243 OHM	79727	RN65D2430F (MIL-R-10509/2)	4.
205-2611	RES FXD FILM 2X61K	79727	RN65D2611F (MIL-R-10509/2)	1.
205-2619	RES FXD FILM 26X1	79727	RN65D26R1F (MIL-R-10509/2)	2.
205-2871	RES FXD FILM 2X87K	79727	RN65D2871F (MIL-R-10509/2)	1.
205-2872	RES FXD FILM 28X7K	79727	RN65D2872F (MIL-R-10509/2)	1.
205-3161	RES FXD FILM 3X16K	79727	RN65D3161F (MIL-R-10509/2)	2.
205-3163	RES FXD FILM 316K	79727	RN65D3163F (MIL-R-10509/2)	2.
205-3572	RES FXD FILM 35X7K	79727	RN65D3572F (MIL-R-10509/2)	1.
205-3830	RES FXD FILM 383	79727	RN65D3830F (MIL-R-10509/2)	2.
205-3839	RES FXD FILM 38X3	79727	RN65D38R3F (MIL-R-10509/2)	1.
205-4220	RES FXD FILM 422	79727	RN65D4220F (MIL-R-10509/2)	1.
205-4221	RES FXD FILM 4X22K	79727	RN65D4221F (MIL-R-10509/2)	1.
205-4640	RES FXD FILM 464	79727	RN65D4640F (MIL-R-10509/2)	1.
205-4872	RES FXD FILM 48X7K	79727	RN65D4872F (MIL-R-10509/2)	1.
205-5111	RES FXD FILM 5X11K	79727	RN65D5111F (MIL-R-10509/2)	1.
205-5112	RES FXD FILM 51X1K	79727	RN65D5112F (MIL-R-10509/2)	2.
205-5621	RES FXD FILM 5X62K	79727	RN65D5621F (MIL-R-10509/2)	2.
205-6190	RES FXD FILM 619	79727	RN65D6190F (MIL-R-10509/2)	1.
205-6811	RES FXD FILM 6X81K	79727	RN65D6811F (MIL-R-10509/2)	1.
205-7152	RES FXD FILM 71X5K	79727	RN65D7152F (MIL-R-10509/2)	2.
205-7321	RES FXD FILM 7X32K	79727	RN65D7321F (MIL-R-10509/2)	2.
205-7322	RES FXD FILM 73X2K	79727	RN65D7322F (MIL-R-10509/2)	1.
205-7323	RES FXD FILM 732K	79727	RN65D7323F (MIL-R-10509/2)	1.
205-7501	RES FXD FILM 7X50K	79727	RN65D7501F (MIL-R-10509/2)	2.
205-8060	RES FXD FILM 806	79727	RN65D8060F (MIL-R-10509/2)	1.
205-8062	RES FXD FILM 80X6K	79727	RN65D8062F (MIL-R-10509/2)	2.
205-8250	RES FXD FILM 825	79727	RN65D8250F (MIL-R-10509/2)	2.
205-8251	RES FXD FILM 8X25K	79727	RN65D8251F (MIL-R-10509/2)	3.
205-8252	RES FXD FILM 82X5K	79727	RN65D8252F (MIL-R-10509/2)	1.
205-9090	RES FXD FILM 909	79727	RN65D9090F (MIL-R-10509/2)	10.
205-9093	RES FXD FILM 909K	79727	RN65D9093F (MIL-R-10509/2)	1.
205-9310	RES FXD FILM 931	79727	RN65D9310F (MIL-R-10509/2)	2.
208-0100	RES FXD COMP 10	01121	RC20GF100K (MIL-R-11/3)	1.
208-0101	RES FXD COMP 100	01121	RC20GF101K (MIL-R-11/3)	3.
208-0102	RES FXD COMP 1X0K	01121	RC20GF102K (MIL-R-11/3)	8.
208-0103	RES FXD COMP 10K	01121	RC20GF103K (MIL-R-11/3)	4.
208-0104	RES FXD COMP 100K	01121	RC20GF104K (MIL-R-11/3)	2.
208-0120	RES FXD COMP 120HM	35009	RC20GF120K (MIL-R-11/3)	1.
208-0151	RES FXD COMP 150	01121	RC20GF151K (MIL-R-11/3)	1.
208-0152	RES FXD COMP 1X5K	01121	RC20GF152K (MIL-R-11/3)	3.
208-0154	RES FXD COMP 150K	01121	RC20GF154K (MIL-R-11/3)	1.
208-0181	RES FXD COMP 180	01121	RC20GF181K (MIL-R-11/3)	1.
208-0222	RES FXD COMP 2X2K	01121	RC20GF222K (MIL-R-11/3)	1.
208-0271	RES FXD COMP 270	01121	RC20GF271K (MIL-R-11/3)	3.
208-0331	RES FXD COMP 330	01121	RC20GF331K (MIL-R-11/3)	3.
208-0332	RES FXD COMP 3X3K	01121	RC20GF332K (MIL-R-11/3)	6.
208-0392	RES FXD COMP 3X9K	01121	RC20GF392K (MIL-R-11/3)	1.
208-0393	RES FXD COMP 39K	01121	RC20GF393K (MIL-R-11/3)	1.
208-0471	RES FXD COMP 470 OHM	01121	RC20GF471K (MIL-R-11/3)	1.
208-0473	RES FXD COMP 47K	01121	RC20GF473K (MIL-R-11/3)	2.
208-0560	RES FXD COMP 56	01121	RC20GF560K (MIL-R-11/3)	3.
208-0562	RES FXD COMP 5X6K	01121	RC20GF562K (MIL-R-11/3)	2.
208-0680	RES FXD COMP 68	01121	RC20GF680K (MIL-R-11/3)	5.
208-0681	RES FXD COMP 680	01121	RC20GF681K (MIL-R-11/3)	1.
208-0821	RES FXD COMP 820	01121	RC20GF821K (MIL-R-11/3)	2.
208-0822	RES FXD COMP 8X2K	01121	RC20GF822K (MIL-R-11/3)	1.
209-0101	RES FXD COMP 100	01121	RC32GF101K (MIL-R-11/6B)	1.
210-0101	RES FXD COMP 100 OHM	01121	RC42GF101K (MIL-R-11/7B)	1.
211-1001	RES FXD FILM 1X0K	17864	RN55D1001F (MIL-R-10509/7B)	5.
211-1003	RES FXD FILM 100K	07115	RN55D1003F (MIL-R-10509/7B)	1.
211-1102	RES FXD FILM 11X0K	07115	RN55D1102F (MIL-R-10509/7B)	2.
211-1211	RES FXD FILM 1X21K	17864	RN55D1211F (MIL-R-10509/7B)	1.
211-1212	RES FXD FILM 12X1K	07115	RN55D1212F (MIL-R-10509/7B)	1.
211-2150	RES FXD FILM 215	17864	RN55D2150F (MIL-R-10509/7B)	1.
211-3161	RES FXD FILM 3X16K	07115	RN55D3161F (MIL-R-10509/7B)	1.
211-3481	RES FXD FILM 3X48K	07115	RN55D3481F (MIL-R-10509/7B)	10.
211-3482	RES FXD FILM 34X8K	07115	RN55D3482F (MIL-R-10509/7B)	2.
211-3489	RES FXD FILM 34X8	17864	RN55D3489F (MIL-R-10509/7B)	2.
211-4221	RES FXD FILM 4X22K	07115	RN55D4221F (MIL-R-10509/7B)	1.
211-5622	RES FXD FILM 56X2 K	07115	RN55D5622F (MIL-R-10509/7B)	1.
211-7500	RES FXD FILM 750 OHM	07115	RN55D7500F (MIL-R-10509/7B)	4.
211-9091	RES FXD FILM 9X09K	17864	RN55D9091F (MIL-R-10509/7B)	2.

TRACOR STOCK NUMBER	DESCRIPTION	MANUFACTURER CODE NUMBER	MANUFACTURER PART NUMBER	TOTAL QUANTITY
214-9301	RES FXD WW 3X0 OHM	12697	RW59V3R0 (MIL-R-26)	2.
218-0020	SCR FLAT HD 4 40X5/16	73734	2132	1.
218-0048	SCR FLAT HD 4 40X3/4	73734	2137	2.
220-0024	SCR FLAT HD 6 32X3/8	73734	2143	16.
223-0032	SCR FLAT HD 10 32X1/2	73734	2185	4.
242-0020	SCR FIL HD 6 32X5/16	73734	2243	1.
242-0024	SCR FIL HD 6 32X3/8L	73734	2244	4.
365-0024	SCR HEX HD 4 40X3/8L	73734	5302	8.
399-0016	SCR BUT HD 4 40	73734	BUT HD SOC CAP 4-40X1/4L	4.
399-0024	SCR BUT HD 4 40	73734	BUT HD SOC CAP 4-40X3/8L	5.
561-0024	SCR BUT HD 6 32X3/8L	73734	BUT HD SOC CAP 6-32X3/8 NI PL	6.
610-0742	TERMINAL	71279	1010-3	64.
611-0053	FERRULE	71279	1952-1	8.
612-0003	HANDLE	71279	1221-1	4.
612-0017	HANDLE	71279	2111-2-02	2.
617-0248	WASHER FLAT NO 2	73734	1400	6.
617-0256	WASHER FLAT NO 4	73734	1402	45.
617-0267	WASHER FLAT NO 6	73734	1404	23.
617-0270	WASHER FLAT NO 8	73734	MS15795-207	1.
620-0121	WASHER LOCK INT NO 2	73734	1300	6.
620-0123	WASHER LOCK INT NO 4	73734	1302	113.
620-0125	WASHER LOCK INT NO 6	73734	1304	156.
620-0126	WASHER LOCK INT NO 8	73734	1305	5.
621-0121	WASHER LOCK INT 1/4	73734	30-120	1.
621-0125	WASHER LOCK INT 3/8	73734	1315	3.
639-0006	WASHER NYLON NO 4	73734	103200	10.
647-0010	NUT SERRATED	73734	76330-NP	1.
649-0034	NUT HEX 2 56X3/16AF	73734	8000	6.
649-0074	NUT HEX 4 40X1/4AF	73734	8003	34.
649-0114	NUT HEX 6-32X1/4AF	73734	8005	37.
649-0134	NUT HEX 8-32X5/16AF	73734	8008	5.
651-0005	NUT HEX 4 40X3/16 AF	73734	8002A	2.
651-0017	NUT HEX 6 32X1/4AF	73734	8005	4.
653-0016	WASHER FLAT 3/8	73734	1498	3.
653-0019	WASHER FLAT 15/32	73734	1499	1.
703-0010	WIRE 18AWG BLK STRD	70903	8501-BLACK	48.
703-0110	WIRE 18AWG BRN STRD	70903	8501-BROWN	11.
703-0210	WIRE 18AWG RED STRD	70903	8501-RED	45.
703-0310	WIRE 18AWG ORN STRD	70903	8501-ORANGE	51.
703-0410	WIRE 18AWG YEL STRD	70903	8501-YELLOW	42.
703-0510	WIRE 18AWG GRN STRD	70903	8501-GREEN	29.
703-0610	WIRE 18AWG BLUE STRD	70903	8501-BLUE	35.
703-0710	WIRE 18AWG VIO STRD	70903	8501-VIOLET	10.
703-0810	WIRE 18AWG GRAY STRD	70903	8501-GRAY	48.
703-0900	WIRE 18AWG WH/BLK	70903	8501-WHITE WITH BLACK STRIPE	18.
703-0905	WIRE 18AWG WH/GRN	70903	8501-WHITE WITH GREEN STRIPE	30.
703-0908	WIRE 18AWG WH/GRAY	70903	8501-WHITE WITH GRAY STRIPE	30.
703-0910	WIRE 18AWG WH STRD	70903	8501-WHITE	29.
705-0010	WIRE 22AWG BLK STRD	70903	8503 BLK (MIL-W-16878)	133.
705-0110	WIRE 22AWG BRN STRD	70903	8503 BRN (MIL-W-16878)	111.
705-0210	WIRE 22AWG RED STRD	70903	8503 RED (MIL-W-16878)	133.
705-0310	WIRE 22AWG ORN STRD	70903	8503 ORN (MIL-W-16878)	111.
705-0410	WIRE 22AWG YEL STRD	70903	8503 YEL (MIL-W-16878)	111.
705-0510	WIRE 22AWG GRN STRD	70903	8503 GRN (MIL-W-16878)	129.
705-0610	WIRE 22AWG BLU STRD	70903	8503 BLU (MIL-W-16878)	111.
705-0710	WIRE 22AWG VIO STRD	70903	8503 VIO (MIL-W-16878)	111.
705-0810	WIRE 22AWG GRY STRD	70903	8503 GRY (MIL-W-16878)	111.
705-0900	WIRE 22AWG WHT/BLK	70903	8503 WHT/BLK (MIL-W-16878)	111.
705-0901	WIRE 22AWG WHT/BRN	70903	8503 WHT/BRN (MIL-W-16878)	111.
705-0902	WIRE 22AWG WHT/RED	70903	8503 WHT/RED (MIL-W-16878)	132.
705-0903	WIRE 22AWG WHT/ORN	70903	8503 WHT/ORN (MIL-W-16878)	37.
705-0904	WIRE 22AWG WHT/YEL	70903	8503 WHT/YEL (MIL-W-16878)	111.
705-0905	WIRE 22AWG WHT/GRN	70903	8503 WHT/GRN (MIL-W-16878)	61.
705-0906	WIRE 22AWG WHT/BLU	70903	8503 WHT/BLU (MIL-W-16848)	57.
705-0907	WIRE 22AWG WHT/VIO	70903	8503-WHT/VIO (MIL-W-16878)	37.
705-0908	WIRE 22AWG WHT/GRY	70903	8503-WHT/GRY (MIL-W-16878)	37.
705-0910	WIRE 22AWG WHT STRD	70903	8503-WHT (MIL-W-16878)	111.
706-0010	WIRE 26AWG BLK	70903	8505-BLACK	REF
706-0110	WIRE 26AWG BRN	70903	8505-BROWN	REF
706-0210	WIRE 26AWG RED	70903	8505-RED	REF
706-0310	WIRE 26AWG ORN	70903	8505-ORANGE	REF
706-0410	WIRE 26AWG YEL	70903	8505-YELLOW	REF
706-0510	WIRE 26AWG GRN	70903	8505-GREEN	REF
706-0610	WIRE 26AWG BLUE	70903	8505-BLUE	REF
706-0710	WIRE 26AWG VIO	70903	8505-VIOLET	REF
706-0810	WIRE 26AWG GRAY	70903	8505-GRAY	REF
706-0900	WIRE 26AWG WHT/BLK	70903	8505-WHITE WITH BLACK STRIPE	REF
706-0901	WIRE 26AWG WHT/BRN	70903	8505-WHITE WITH BROWN STRIPE	REF
706-0902	WIRE 26AWG WHT/RED	70903	8505-WHITE WITH RED STRIPE	REF
706-0903	WIRE 26AWG WHT/ORN	70903	8505-WHITE WITH ORANGE STRIPE	REF
706-0904	WIRE 26AWG WHT/YEL	70903	8505-WHITE WITH YELLOW STRIPE	REF
706-0905	WIRE 26AWG WHT/GRN	70903	8505-WHITE WITH GREEN STRIPE	REF
706-0906	WIRE 26AWG WHT/BLUE	70903	8505-WHITE WITH BLUE STRIPE	REF
706-0907	WIRE 26AWG WHT/VIOLET	70903	8505-WHITE WITH VIOLET STRIPE	REF
706-0908	WIRE 26AWG WHT/GRAY	70903	8505-WHITE WITH GREY STRIPE	REF

TRACOR STOCK NUMBER	DESCRIPTION	MANUFACTURER CODE NUMBER	MANUFACTURER PART NUMBER	TOTAL QUANTITY
706-0910	WIRE 26AWG WHT	70903	8505-WHITE	REF
800-0662	DIODE 1N662	01295	1N662	2.
800-0750	DIODE 1N750	01295	1N750	1.
800-0914	DIODE 1N914	01295	1N914	9.
800-4002	DIODE 1N4002	04713	1N4002	8.
801-0096	DIODE 1N96A	73293	1N96A	52.
801-0456	DIODE 1N456A	01295	1N456A	6.
801-0746	DIODE 1N746A	01295	1N746A	1.
801-0752	DIODE 1N752A	01295	1N752A	5.
801-0753	DIODE 1N753A	01295	1N753A	5.
900-0708	TSTR 2N708	01295	2N708	6.
900-0963	TSTR 2N963	01295	2N963	1.
900-1038	TSTR 2N1038	01295	2N1038	1.
900-1304	TSTR 2N1304	01295	2N1304	64.
900-1305	TSTR 2N1305	01295	2N1305	62.
900-1319	TSTR 2N1319	01295	2N1319	2.
900-1363	TSTR 2N1363	01295	2N1363	1.
900-1995	TSTR 2N1995	01295	2N1995	4.
900-2102	TSTR 2N2102	01295	2N2102	6.
900-2218	TSTR 2N2218	04713	2N2218	15.
900-2270	TSTR 2N2270	01295	2N2270	45.
900-2280	TSTR 2N2280	56289	2N2280	8.
900-3055	TSTR 2N3055	01295	2N2055	1.
900-3134	TSTR 2N3134	01295	2N3134	13.
900-3702	TSTR 2N3702	01295	2N3702	2.
900-3705	TSTR 2N3705	01295	2N3705	1.
900-3708	TSTR 2N3708	01295	2N3708	2.
902-0711	TSTR 2N711B	01295	2N711B	10.
902-1671	TSTR 2N1671B	01295	2N1671B	1.
3311-0553	TERMINAL STRIP 3 PIN	71785	3-141-Y	1.
3317-9332	CAP FXD MYLAR X33MFD	04099	MMW33425	1.
3317-9473	CAP FXD MYLAR X047MFD	04099	MMW47325	2.
3318-0028	CONN PLUG ELEC 22 PIN	02660	133-022-03	8.
3318-5016	CONN RECP ELEC 22 PIN	02660	143-022-01	8.
3318-5017	CONN RECP ELEC 22 PIN	02660	143-022-03	1.
3319-0152	CAP FXD CER 1500 PFD	71590	DD-152	22.
3319-0271	CAP FXD CER 270PFD	71590	DD271	3.
3319-0272	CAP FXD CER 2700PFD	71590	DD272	11.
3319-0471	CAP FXD CER 470PFD	71590	DD471	30.
3319-0751	CAP FXD CER 750PFD	71590	DD751	2.
3320-9102	CAP FXD CER X1MFD	71590	UK104	11.
3321-9102	CAP FXD CER X1 MFD	71590	UK10-104	4.
3323-9224	CAP FXD MYL X0022 MFD	56289	192P22252	1.
3324-9102	CAP FXD MYL X10 MFD	56289	192P10492	2.
3324-9103	CAP FXD MYL X01 MFD	56289	192P10392	1.
3324-9104	CAP FXD MYL X001 MFD	56289	192P10292	4.
3324-9153	CAP FXD MYL X015 MFD	56289	192P15392	1.
3324-9154	CAP FXD MYL X0015MF	56289	192P15292	3.
3324-9223	CAP FXD MYL X022MFD	56289	192P22392	1.
3324-9224	CAP FXD MYL X0022 MFD	56289	192P22292	2.
3324-9334	CAP FXD MYL X0033MFD	56289	192P33292	1.
3324-9394	CAP FXD MYL X0039MFD	56289	192P39292	1.
3324-9474	CAP FXD MYL X0047MFD	56289	192P47492	1.
3324-9475	CAP FXD MYL X00047MFD	56289	192P47192	2.
3326-0032	RIVET POP 3/32X2/2	07707	AD32BS	28.
3326-0042	RIVET POP 1/8X232	07707	AD42BS	20.
3326-0043	RIVET POP 1/8X294	07707	AD43BS	6.
3326-0044	RIVET POP 1/8X357	07707	AD44BS	12.
3326-0045	RIVET POP 1/8X419	07707	AD45BS	33.
3326-0046	RIVET POP 1/8X481	04707	AD46BS	30.
3326-0132	RIVET POP 3/32X212	07707	AD32ABS	12.
3326-1043	RIVET POP 1/8X294	07707	SD43BS	24.
3331-0022	NUT CLINCH 4-40	46384	CL-440-1 CAD PL STL	45.
3331-0031	NUT CLINCH 6-32	46384	CL-632-1 STL	24.
3331-0032	NUT CLINCH 6-32	46384	CL-632-1 CAD CHR STL	17.
3331-0037	NUT CLINCH 6-32	46384	CL-632-2 CAD PL STL	12.
3335-0101	CAP FXD ELECT 100 MFD	46289	TE1059.5	3.
3338-0251	CAP FXD ELECT 250 MFD	56289	TE-1138 OR 30D257G012DH0	3.
3340-0100	CAP FXD METAL 10 MFD	56289	TE-1204	4.
3340-9101	CAP FXD METAL X1MFD	56289	TE1200	3.
3346-9201	FUSE 2A 125 VOLT	98997	8AG2A-125V	6.
3346-9501	FUSE 5A 125 VOLT	75915	361005	6.
3388-0028	CABLE COAXIAL	70903	RG58C/U (MIL-C-17/28A)	100.
3388-0092	CABLE COAXTAL	70903	RG-178B/W (MIL-C-17A/93B)	6.
3388-0116	CABLE COAXIAL	02660	RG-174/U (MIL-C-17/119A)	6.
3389-0011	TAPE LACING	70331	LC134 WHITE	REF
3390	CONN BNC FEMALE	02660	UG-88E/U	2.
3391	(SAME AS 3391-0001)	02660	UG-657/U	8.
3392-0011	CONN MALE 16 PIN	02660	26-4301-16P	1.
3392-1006	CONN FEMALE	02660	26-4401-16S	1.
3394-0003	CONN MALE 16 PIN	02660	26-4100-16P	2.
3394-0004	CONN MALE 24 PIN	02660	26-4100-24P	4.
3394-1003	CONN FEMALE 16 PIN	02660	26-4200-16S	2.
3394-1004	CONN FEMALE 24 PIN	02660	26-4200-24S	4.
3403-9103	CAP FXD CER X01 MFD	80183	TG-S10	7.

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3404-9472	CAP FXD CER X47 MFD	80183	HY-130	3.
3408-9502	CAP FXD CER X5 MFD	56289	CP53B1EF504K (MIL-C-25/4)	1.
3422-0472	INDUCTOR 4700MH	99800	2500-60	3.
3423-9601	INDUCTOR 6 MH	80223	ML7	1.
3426-0013	TUBING TEFLON NO 24	70331	TFT-200/24NAT	REF
3428-0002	MTG KIT PWR TSTR	04713	MK-15	2.
3429	MTG KIT TSTR 2N673	08289	PK-14-M OR NEW PK-22-14-M	4.
3432-0001	DIODE NON JEDEC	01295	G129	2.
3440-2200	HOLDER LAMP RED	72765	51-304/RED	2.
3440-2500	HOLDER LAMP GREEN	72765	51-304/GREEN	1.
3440-2900	HOLDER LAMP WHITE	72765	51-304/WHITE	1.
3455-0772	CLAMP CABLE 3/16	83330	772	6.
3455-0773	CLAMP CABLE 1/4	83330	773	4.
3458-0001	KNOB	94144	50-2-1G OR 0D1B	1.
3458-0094	KNOB SKTD POINTER	94144	70-5-2G OR 1K1B	3.
3459-0003	CONN PLUG ELEC	02660	160-3	1.
3463-0001	TRIMMER	72656	TA-01-A	1.
3464-0001	CUP CORE PAIR	72656	TC3-01-100	1.
3465-0002	BOBBIN	72656	BB-01-2	1.
3466-0001	BKT ASSY	72656	BA-01-R	1.
3467-0016	CABLE POWER	70331	636	1.
3468-1103	RELAY 4PDT 24VDC	77342	KHP17D11-24VDC	1.
3469-0001	RELAY SOCKET	77342	27E006	1.
3472-0001	SHAFT LOCK BLACK	94144	SL-100B	1.
3473-0001	COUPLING 1/4 X 1/4	99934	A-201-5	1.
3475-0001	SCR CAPTIVE 6 32NC	88245	3200-6-12	10.
3481-0014	CAP FXD ELECT 1K	80183	TVL-1338	2.
3482-0001	CAP FXD ELECT 1K/1K	56289	TVL-2160	2.
3486-0001	LUG TERMINAL NO 4	73734	9600 (MS35431-1)	4.
3486-0005	LUG TERMINAL NO 6	73734	1904	1.
3486-0009	LUG TERMINAL NO 8	73734	1905	4.
3486-0027	LUG TERMINAL 3/8	73734	118100	1.
3487-9252	FUSE 1/4 AMP	71400	MDL1-4A	7.
3488-0002	HOLDER FUSE	71400	HKP-H	2.
3489-0002	HOLDER FUSE	71400	HJM-H	2.
3490-0002	SWITCH TOGGLE DPST	72653	34-182	2.
3501-0034	WIRE MAGNET 34 AWG	09040	SOLDEREZE SIZE 34	REF
3522-0502	RES VAR 5K	01121	RV4LAYSA502A (MIL-R-94/5A)	3.
3523-0502	RES VAR 5K LOG	01121	RV4LAYSA502C (MIL-R-94/5)	1.
3559-0002	ADAPTER GROUND	82879	210	1.
3560-0002	NUT LOCK 3/8 32	01121	M-3318	3.
3564-0251	CAP TA ELECT 250 10V	56289	CL45BD251MP3 (MIL-C-3965/4)	1.
3567-9401	CAP FXD MYLAR 4 MFD	02777	4PP5D	1.
3568-0100	INDUCTOR 10 UH	99800	1537-36	1.
3568-0101	INDUCTOR 100 UH	99800	1537-76	3.
3568-0150	INDUCTOR 15 UH	99800	1537-40	2.
3568-0201	INDUCTOR 200 UH	99800	1537-90	5.
3568-0270	INDUCTOR 27 UH	99800	1537-48	9.
3568-9391	INDUCTOR 3X9 UH	99800	1537-26	1.
3568-9471	INDUCTOR 4X9 UH	99800	1537-28	1.
3570-0008	TAPE ELECTRICAL	76381	NO 56-1/8	REF
3571-0753	STRAP TIE DOWN 3 INCH	98159	2829-75-3	4.
3573-0001	SWITCH PUSHBUTTON NC	81073	30-1	2.
3575-0102	RES VAR 1K	80294	271-1-102	1.
3575-0202	RES VAR 2K	80294	271-1-202	1.
3580-0500	RES VAR 50 OHM	80294	200L-1-500	1.
3583-0103	RES VAR 10K	80294	200S-1-103M	1.
3596-0101	RES VAR 100 OHM	80294	3067P-1-101	2.
3596-0202	RES VAR 2000 OHM	80294	3067P-1-202	1.
3596-0502	RES VAR 5K	80294	3067P-1-502	1.
3598-0104	RES VAR 100K	80294	3068P-1-104	1.
3598-0503	RES VAR 50K	80294	3068P-1-503	1.
3608-0502	RES VAR 5K 1/2W	01121	RV6NAYSD502A	1.
3611-9472	CAP FXD MYLR X47 MFD	09134	31-474C	1.
3611-9473	CAP FXD MYLR X047 MFD	09134	31-473C	4.
3612-9102	CAP FXD MYLR X1 MFD	09134	25-104C	5.
3612-9223	CAP FXD MYLR X022 MFD	09134	25-223C	1.
3616-0001	SHIELD CO-NETIC FOIL	06682	AAFOIL 4X004	REF
3628-0015	CONNECTOR PCB 15 PIN	71785	50-15A-20 SERIES 250	1.
3628-0022	CONNECTOR PCB 22 PIN	71785	50-22A-20	1.
3630-0001	CRYSTAL 1000 KC	00815	NE 6A 1000 KC	1.
3630-0002	CRYSTAL 10000.00 KC	00815	NE6A10000.00KC	1.
3631-0001	HOLDER CRYSTAL	91506	8000 DG1	2.
3632-0011	CAP VAR .8-30 PFD	73899	VC43GWY	2.
3633-0001	SWITCH SLIDE	42190	4633	1.
3634-0001	SOCKET OCTAL	02660	88-8	4.
3639-2002	SWITCH ROTARY	71590	PA-2002	1.
3640-0004	SWITCH TOGGLE	15605	8867K4	1.
3641-0002	SWITCH SLIDE	72653	34-162	1.
3642-0016	SWITCH LEVER	82389	130312	1.
3643	SWITCH ROTARY	31356	V71091S-SR05N30C2MG	1.
3644	SWITCH ROTARY	31356	V72064S-SR0 5N30C2MG	1.
3645-0034	TRANSFORMER	80223	D0-T34	1.
3645-0036	TRANSFORMER	80223	D0-T36	1.
3646	SHIELD	80223	D0-TSH	2.

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3647-0302	CONN PLUG ELEC	81312	8B20S-0	3.
3648-0008	CONN PLUG ELEC	71785	S306AB	1.
3649-0005	SPEAKER	74199	30A05	1.
3650-0001	PAPER CHART ROLL	14869	TYPE A	2.
3651-0152	RES TEMP SENS 152 K	01295	TM 1/4-152 K	1.
3652-0203	RES VAR 20K	75042	310 200000HMS	1.
3653-9151	INDUCTOR	72259	VIV1.5	1.
3654-9101	RES FXD PREC WW 1 OHM	91637	RS1A1.00 OHM	1.
3655-1001	CAP FXD POLY X001 MFD	84171	PE102J	8.
3655-5001	CAP FXD POLY X005 MFD	84171	PE502J	1.
3656-1003	CAP FXD POLY X1 MFD	84171	1PJ 104F	2.
3656-2003	CAP FXD POLY X2 MFD	84171	1PJ 204F	1.
3656-5001	CAP FXD POLY X005 MFD	84171	1PJ502F	6.
3657-0001	PAD MTG TSTR	07047	10171-N	25.
3657-0013	PAD MTG TSTR	07047	10030-DAP	1.
3803-0024	PLUG SNAP 3/8 HOLE	72653	1711-C	2.
3805-0011	BOLT SPADE 6-32	73734	5467	4.
3805-0041	BOLT SPADE 6-32	73734	5469	2.
3806-0001	ADHESIVE	98911	TYPE A-6	1.
3806-0020	ADHESIVE ACTIVATOR	98911	TYPE A	1.
3807-0001	RUBBER STRIP SPONGE	77969	SPONGE RUBBER 5/32X3/8	19.
3807-0022	RUBBER STRIP SPONGE	77969	SPONGE RUBBER SHIM 7/16X1/2	10.
3838-0101	RES VAR 100 OHM	73138	62P R100	1.
3878-0001	HEATSINK TO5	13103	2205B	1.
4196-0001	CONN COAX RADIO FREQ	02660	M23329/3-01-03	2.
4750-0016	SPACER NO 6 1/4D	06540	9224-A-141-1B	8.
5057-0032	STANDOFF 4 40X1/2	83330	2332	4.
5067-0048	STANDOFF 6 32NCX3/4L	83330	2323	4.
5067-0100	STANDOFF 6 32X1L	83330	2324	6.
5586-0036	STANDOFF 4 40X9/16	06540	8082-A-0440-1B	2.
5586-0048	STANDOFF 4 40X3/4	06540	8084 A-0440-1B	8.
5586-0108	STANDOFF 4 40X1 1/8	06540	8088-A-0440-1B	2.
5586-0124	STANDOFF 4 40X1 3/8	06540	8092-A-0440-1B	2.
5586-0200	STANDOFF 4 40X2	06540	8099-A-0440-1B	2.
5606-0116	STANDOFF 6 32X1 1/4	06540	8152-A-0632-1B	1.
6152	PLATE IDENT	19397	6152	4.
7173	TSTR ASSY 2N673 MOD	19397	7173	5.
8145	CHANNEL BOTTOM	19397	8145	2.
8819-0018	WIRE BUS BAR 18AWG	70903	8019	REF
8819-0020	WIRE BUS BAR 20 AWG	70903	8020	2.
8819-0022	WIRE BUS BAR 22AWG	70903	8021	REF
8914-0101	CAP FXD ELEC 100 MFD	01295	CS13BE106K (MIL-C-26655/2D)	3.
8914-0150	CAP FXD ELECT 15 MFD	05397	CS13BE156K (MIL-L-26655/2D)	2.
8916-0121	CAP FXD TA 120MF 15V	05397	CS13BD127K (MIL-C-26655/2D)	2.
8916-9331	CAP FXD TA 3X3 MFD	05397	CS13BD335K (MIL-C-26655/2D)	15.
8917-0121	CAP FXD TA 120 10V	01295	CS13BC127K (MIL-C-26655/2D)	20.
8917-0390	CAP FXD TA 39 MFD	05397	CS13BC396K (MIL-C-26655/2D)	3.
8917-9471	CAP FXD TA 4X7MFD	05397	CS13BC475K (MIL-C-26655/2D)	10.
8918-0331	CAP FXD TA 330 MFD	05397	CS13BB337K (MIL-C-26655/2D)	3.
8918-0560	CAP FXD TA 56 MFD	05397	CS13BB566K (MIL-C-26655/2D)	6.
8918-9681	CAP FXD TA 6X8 MFD	05397	CS13BB685K (MIL-C-26655/2D)	1.
9008	TRANSFORMER POWER	19737	9008	1.
21472-0003	INK MARKING	79436	CAT-L-INK 50-710	REF
21485-9101	CAP FXD TA 1X0 MFD	05397	CS13BF105K (MIL-C-26655/2D)	3.
21485-9332	CAP FXD TA MFD 35V	05397	CS13BF334K (MIL-C-26655/2)	1.
27511-0561	CAP FXD MICA 560 PF	00853	CM20FD61GN3 (MIL-C-5/2)	2.
27512-0121	CAP FXD MICA 120 PFD	00853	CM05F121G03 (MIL-C-5/18)	1.
27512-0151	CAP FXD MICA 150 PFD	00853	CM05F151G03 (MIL-C-5/18)	1.
27512-0180	CAP FXD MICA 18 PFD	00853	CM05C180K03 (MIL-C-5/18)	2.
27512-0181	CAP FXD MICA 180 PFD	00853	CM05F181G03 (MIL-C-5/18)	4.
27512-0220	CAP FXD MICA 22 PFD	00853	CM05E220J03 (MIL-C-5/18)	5.
27512-0221	CAP FXD MICA 220 PFD	00853	CM05F221G03 (MIL-C-5/18)	1.
27512-0271	CAP FXD MICA 270 PFD	00853	CM05F271G03 (MIL-C-5/18)	10.
27512-0331	CAP FXD MICA 330 PFD	00853	CM05F331G03 (MIL-C-5/18)	2.
27512-0471	CAP FXD MICA 470 PFD	00853	CM06F471G03 (MIL-C-5/18)	1.
27512-0680	CAP FXD MICA 68 PFD	00853	CM05E680G03 (MIL-C-5/18)	1.
27512-0820	CAP FXD MICA 80 PFD	00853	CM05E820G03 (MIL-C-5/18)	1.
27512-0821	CAP FXD MICA 820 PFD	00853	CM06F821G03 (MIL-C-5/18)	1.
27513-0471	CAP FXD MICA 470 PFD	84171	DM-15-471G	5.
27513-0561	CAP FXD MICA 560 PFD	84171	DM-15-561G	3.
599016-0001	BAR CHASSIS	19397	599016-0001	1.
599016-0002	BAR CHASSIS	19397	599016-0002	1.
599016-0003	BAR CHASSIS	19397	599016-0003	1.
599017-0006	RAIL GUIDE	19397	599017-0006	8.
599019-0001	COVER BOTTOM	19397	599019-0001	1.
599019-0002	COVER TOP	19397	599019-0002	1.
599023	BRACKET CONN PANEL	19397	599023	2.
599024	PANEL CONN INTERNAL	19397	599024	1.
599028	TOP RAIL	19397	599028	2.
599029	BOTTOM RAIL	19397	599029	1.
599033	BRACKET COMP MTG	19397	599033	1.
599034	BRACKET COMP MTG	19397	599034	1.
599038	COVER	19397	599038	2.
599058	HEAT SINK	19397	599058	1.
599059	COVER COMP	19397	599059	1.

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599060	BRACKET CAP MTG	19397	599060	1.
599077	HEAT SINK	19397	599077	1.
599079	GROUND BUS INT PANEL	19397	599079	1.
599102	GUIDE PIN	19397	599102	2.
599105	BRACKET CAP MTG	19397	599105	1.
599106	STANDOFF	19397	599106	2.
599109	CARRIER LEVEL METER	19397	599109	1.
599168	ASSY ANTENNA CABLE	19397	599168	1.
599175-0000	FILTER RF SELECTED FR	19397	599175-0000 SELECTED FREQ	REF
599177	FILTER IF BANDPASS	19397	599177	1.
599180	XFMR DUAL BIFILAR	19397	599180	1.
599184	BOARD PRINTED CKT	19397	599184	1.
599185	BROAD PRINTED CKT	19397	599185	1.
599186	BROAD PRINTED CKT	19397	599186	1.
599187	BROAD PRINTED CKT	19397	599187	1.
599195	BOARD PRINTED CKT	19397	599195	1.
599196	BOARD PRINTED CKT	19397	599196	1.
599203	PANEL FRONT	19397	599203	1.
599204	BOARD PRINTED CKT	19397	599204	1.
599209	COVER MODULE	19397	599209	1.
599210	COVER ACCESS	19397	599210	1.
599211	SHIELD CHASSIS BRACE	19397	599211	1.
599213	SUPPORT CHASSIS	19397	599213	4.
599217	BRACKET RECORDER INT	19397	599217	1.
599238	DIODE 1N663 SELECTED	19397	599238	1.
599239	DIODE 1N663 SELECTED	19397	599239	1.
599246	BRACKET PCB CHASSIS	19397	599246	2.
599247	CHASSIS BOTTOM	19397	599247	1.
599248	BAR CORNER	19397	599248	2.
599249	GUIDE PCB	19397	599249	16.
599250	COVER ACCESS	19397	599249	1.
599253-0110	SPACER	19397	599253-0110	9.
599255	BRACKET PANEL SPACER	19397	599255	1.
599256	SPACER FRONT	19397	599256	1.
599257	COVER	19397	599257	1.
599266	EXTDR 22 PIN PCB ASSY	19397	599266	1.
599267	CONNECTOR ASSY	19397	599267	1.
599268	CHASSIS BOTTOM	19397	599268	1.
599270	PANEL REAR BLUE	19397	599270	1.
599271	CHASSIS PCB	19397	599271	1.
599272	CHASSIS SUB FRONT	19397	599272	1.
599273-0735	SPACER THREADED	19397	599273-0735	2.
599273-2925	SPACER THREADED	19397	599273-2925	2.
599274	BAR PCB CHASSIS	19397	599274	2.
599282	CABLE 16 PIN ASSY	19397	599282	2.
599283	CABLE 24 PIN ASSY	19397	599283	1.
599284	SPACER ACTUATOR	19397	599284	1.
599287-0001	RECORDER	19397	599287-0001	1.
599288	SWITCH THUMBWHEEL	19397	599288	1.
599289	BOARD PRINTED CKT	19397	599289	1.
599290	BOARD PRINTED CKT	19397	599290	1.
599312	BUSS GROUND EXTERNAL	19397	599312	1.
599314	INSULATOR ANT INPUT	19397	599314	1.
599318	INDUCTOR .5 HY	19397	599318	1.
599319	TRANSFORMER	19397	599319	1.
599322-0001	BRACKET END LEFT	19397	599322-0001	1.
599354	BOARD PRINTED CKT	19397	599354	1.
599355	BOARD PRINTED CKT	19397	599355	1.
599356	PANEL REAR BLACK	19397	599356	1.
599357	TSTR MATCHED	19397	ORDER TO SPEC 599357	1.
599358	BOARD TERMINAL	19397	599358	1.
599359	PANEL FRONT	19397	599359	1.
599360	BOARD PRINT CKT	19397	599360	1.
599361	PIN GUIDE RECT	19397	599361	3.
599363	PANEL REAR RED	19397	599363	1.
599368-0001	BRACKET END RIGHT	19397	599368-0001	1.
599369-0002	PANEL CONN EXTERNAL	19397	599369-0002	1.
599370	CLAMP	19397	599370	1.
599378	ASSY CHAS 599H VLF	19397	599378	1.
599380	HARNESS ASSY	19397	599380	1.
599384	ASSY WIRING HARNESS	19397	599384	1.
599391	TSTR MATCHED	19397	ORDER TO SPEC 599391	1.
599394	ASSY PHASE SERVO	19397	599394	1.
599397	SHELL PROTECTIVE	19397	599397	1.
599403	COUNTER	19397	599403	1.
599409	PLATE ESCUTCHEON	19397	599409	1.
599456	PANEL FRONT	19397	599456	1.
599483	PHASE ERROR METER	19397	599483	1.
599534	INDUCTOR 3X3 MH	19397	599534	1.
599535	COIL ASSY	19397	599535	REF
599550	BOARD PRINTED CKT	19397	599550	1.
599552	ASSY PCB AUDIO AMPL	19397	599552	1.
599562	INDUCTOR TOR 100MH	19397	599562	1.
599564	SCHIELD PCB	19397	599564	1.
599568	ASSY PCB RECEIVER	19397	599568	1.

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599569	ASSY PCB LO LIM/FILT	19397	599569	1.
599570	ASSY PCB PHASE SHIFT	19397	599570	1.
599589	ASSY PCB PRESET COUNT	19397	599589	1.
599590	ASSY PCB VCO AND CONT	19397	599590	1.
599591	ASSY PCB CONT LOOP 2	19397	599591	1.
599592	ASSY PCB LIM FREQ D1Y	19397	599592	1.
599593	ASSY PCB COARSE TUNE	19397	599593	1.
599594	ASSY PCB BB FIL/ETC	19397	599594	1.
599595	ASSY PCB ATTENUATOR	19397	599595	1.
599596	ASSY PCB	19397	599596	1.
599597	ASSY TERMINAL BOARD	19397	599597	1.
599599	ASSY WIRING HARNESS	19397	599599	1.
599623	PANEL CONN ASSY	19397	599623	1.
599624	MODULE RCVR/PH ASSY	19397	599624	1.
599625	ASSY WIRING HARNESS	19397	599625	1.
599626	ASSY AGC/PHASE MODULE	19397	599626	1.
599663	PLATE CHART INST	14864	SUPPLIED W/RECORDER	1.
599664	PLATE RECORDER DATA	14864	SUPPLIED W/RECORDER	1.
599665	CARD WARRANTY	14869	SUPPLIED W/RUSTRAK RECORDER	1.
599666	SCALE CHART	14869	SUPPLIED W/RECORDER	1.
599667	BEARING PANEL	19397	599667	1.
599720	BOARD PRINTED CKT	19397	599720	1.
599721	PCB ASSY	19397	599721	1.
599722	HARNESS WIRING ASSY	19397	599722	1.
599723	MODULE PWR SUP ASSY	19397	599723	1.
599724	PANEL REAR GOLD	19397	599724	1.
599725	PANEL PAINTED FRONT	19397	599725	1.
599786	BOARD PRINTED CKT	19397	599786	1.
599788	BOARD PRINTED CKT	19397	599788	2.
599797	HARNESS WIRING ASSY	19397	599797	1.
599806	MANUAL OPS SERVICE	19397	599806	2.
599811	ACCESSORY PARTS ASSY	19397	599811	1.

NUMERIC LIST OF MANUFACTURER CODES

CODE NO.	MANUFACTURER	ADDRESS
00141	PIC DESIGN CORP	EAST ROCKAWAY N Y
00328	STERLING INST DIV OF DESIGNATRONICS INC	MINEOLA LONG ISLAND N Y
00348	MICROTRAN CO INC	VALLEY STREAM N Y
00544	METAL CAL A DIVISION OF AVERY ADHESIVE PRODUCTS INC	INGLEWOOD CALIF
00656	AEROVOX CORP	NEW BEDFORD MASS
00779	AMP INC	HARRISBURG PA
00781	AIRCRAFT RADIO CORP	BOONTON N J
00815	NORTHERN ENGINEERING LABORATORIES INC	BURLINGTON WIS
00853	SANGAMO ELECTRIC CO PICKENS DIVISION	PICKENS S C
01121	ALLEN-BRADLEY CO	MILWAUKEE WIS
01139	GENERAL ELECTRIC SILICONE PRODUCTS DEPT	WATERFORD, NEW YORK
01170	BELLOFRAM CORP	BURLINGTON MASS
12405	HYSOL CORP	EL MONTE CALIF
01281	TRW SEMICONDUCTORS INC	LAWNDALE CALIF
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR-COMPONENTS DIVISION	DALLAS TEX
01351	DYNAMIC GEAR CO INC	AMITYVILLE N Y
01364	ALLIED RADIO CORP	CHICAGO ILL
01561	CHASSIS-TRAK CORP	INDIANAPOLIS IND
01766	INTERNATIONAL CRYSTAL	OKLAHOMA CITY OKLA
18677	SCANBE MFG CO	MONTEREY PARK CALIF
02111	SPECTROL ELECTRONICS CORP	SAN GABRIEL CALIF 91778
02114	FERROXCUBE CORP OF AMERICA	SAUGERTIES N Y
02570	CRAWFORD FITTING CO(SWAGELOK)	SOLON OHIO
02640	TORWICO ELECTRONICS INC	LAKEWOOD N J
02660	AMPHENOL-BORG ELECTRONICS CORP	BROADVIEW CHICAGO ILL
02733	PENN AIRCRAFT PRODUCTS INC	DAYTON, OHIO
02735	RADIO CORP OF AMERICA COMML REC TUBE AND SEMICONDUCTOR DIV	SOMERVILLE N J
02768	FASTEX DIV OF ILLINOIS TOOL WORKS	DES PLAINES ILL
02770	BRISTOL MOTORS DIV OF VOCALINE CO OF AMERICA	OLD SAYBROOK, CONN
02777	HOPKINS ENGINEERING CO	SAN FERNANDO CALIF
02833	ANTENNA SPECIALISTS CO	CLEVELAND OHIO
02863	EMCOR DIV OF INGERSOLL PRODUCTS DIV OF BORG-WARNER CORP	ELGIN ILL
02875	HUDSON TOOL AND DIE CO INC	NEWARK N J
02918	MARKITE CORP	NEW YORK N Y
03481	GOODRICH B F CO AEROSPACE AND DEFENSE PRODUCTS DIVISION	AKRON OHIO
03508	GECO-SEMICONDUCTOR PRODUCTS	SYRACUSE, N Y
03743	APPELTON ELECTRIC	CHICAGO ILL
03756	APPLIED RESEARCH LABORATORIES	GLENDALE CALIF
03765	AUTOMATIC COIL CO	MINEOLA N Y
03797	ELDEMA CORP	COMPTON, CALIF
03877	TRANSITRON ELECTRONIC CORP	WAKEFIELD MASS
03878	SIGNAL MFGR COMPANY	LYNN MASS
03911	CLAIREX CORP	NEW YORK N Y
03945	WHITE INSTRUMENT LABORATORIES	AUSTIN TEX
03954	DIEHL MFG CO A SUBSIDIARY OF SINGER MFG CO	SOMERVILLE N J
03984	GENERAL ELECTRIC CO,SEMI-CONDUCTOR PROD DEPT	CLYDE N Y
04009	ARROW-HART AND HEGEMAN ELECTRIC CO	HARTFORD CONN
04099	CAPCO CAPACITORS	IRVING TEX
04264	CIRCON COMPONENT CORP	GOLETA CALIF 93017
04347	HYSOL CORP	OLEAN N Y
04552	EMERSON AND CUMING INC	CANTON MASS
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS DIVISION	PHOENIX ARIZONA
04814	CHATHAM CONTROLS CORP	CHATHAM N J
05010	THERMISTOR DIVISION OF GULTON INDUSTRIES INC	METUCHEN N J
05236	JONATHAN MFG CO	FULLERTON CALIF
05277	WESTINGHOUSE ELECTRIC CORP SEMI-CONDUCTOR DEPARTMENT	YOUNGWOOD PA
05397	UNION CARBIDE CORP LINDE DIVISION KEMET DEPT	CLEVELAND OHIO
05820	WAKEFIELD ENGINEERING INC	WAKEFIELD MASS
05972	AMERICAN SEALANTS CO (LOCKITE)	HARTFORD,CONN
05972	LOCKITE (AMERICAN SEALANTS CO.)	HARTFORD,CONN
06004	BASSICK CO THE	BRIDGEPORT CONN
06008	NEW DEPARTURE DIVISION OF GENERAL MOTORS CORP	MERIDEN CONN
06540	AMATOM ELECTRONIC HARDWARE CO INC	NEW ROCHELLE N Y
06555	BEEDE ELECTRICAL INSTRUMENT CO	PENACOOK NH 03303
06668	TEXAS INSTRUMENTS INC APPARATUS DIV	HOUSTON TEX
06682	MAGNETIC SHIELD DIVISION OF PERFECTION MICA CO	CHICAGO ILL
06751	SEMCOR DIVISION COMPONENTS INC	PHOENIX ARIZ
06915	RICHCO PLASTIC CO	CHICAGO ILL
07047	ROSS MILTON CO	HATBORO PA
07065	LINE ELECTRIC CO	ORANGE N J
07115	CORNING GLASS WORKS ELECTRONIC COMPONENTS DEPARTMENT	RALEIGH N C
07126	DIGITRAN CO	PASADENA CALIF
07183	DECCO INC	DALLAS TEX
07263	FAIRCHILD CAMERA AND INST CORP SEMICONDUCTOR DIV	MOUNTAIN VIEW CALIF
07707	UNITED SHOE MACHINERY CORP FASTENER DIVISION	SHELTON CONN
07829	BODINE ELECTRIC CO	CHICAGO ILL
07886	NATIONAL RADIO CO INC	MELROSE MASS
07933	RAYTHEON MFG CO SEMICONDUCTOR DIVISION	MOUNTAIN VIEW CALIF
08242	THETA INSTRUMENT CORP	SADDLE BROOK N J
08289	BLINN DELBERT CO	POMONA CALIF
08726	UNIVERSAL TRANSFORMER CO INC	WYLIE TEX
08779	SIGNAL TRANSFORMER CO	BROOKLYN NY
08806	MINIATURE LAMP DEPARTMENT GECO	CLEVELAND OHIO
08987	BROWN INSTRUMENTS DIV OF HONEYWELL INC	MINNEAPOLIS MINN
08987	HONEYWELL INC PHILADELPHIA DIVISION	PHILADELPHIA PA

CODE NO.	MANUFACTURER	ADDRESS
09134	TEXAS CAPACITOR CO	HOUSTON TEX
09145	ATOHM ELECTRONICS	SUN VALLEY CALIF
09709	BULLDOG ELECTRIC PRODUCTS INC	DETROIT MICH
09808	STOCKER HINGE MFG CO	BROOKFIELD, ILL 60513
09922	BURNDY CORP	NORWALK CONN
10108	HURST MFG CORP	PRINCETON,IND
11139	DEUTSCH CO ELECTRONIC COMPONENTS DIVISION	BANNING CALIF
11147	EPOXYLITE CORP	SOUTH EL MONTE, CALIF
11649	CAJON CO	CHICAGO ILL
11700	J B ELECTRONICS	CHICAGO ILL
11907	CALFAX INC	REDONDO BEACH CALIF
12060	DIODES INC	CANOGA PARK CALIF
12136	PHILADELPHIA HANDLE CO.	CAMDEN, N. J.
12599	FLUOROCARBON CO	ANAHEIM CALIF
12697	CLAROSTAT MFG CO INC	DOVER N H
12760	OWEN-CORNING FIBERGLAS CORP	SANTA CLARA CALIF
12954	DICKSON ELECTRONICS CORP	SCOTTSDALE ARIZ
12969	UNITRODE CORP	WATERTOWN MASS
13103	THERMALLOY CO	DALLAS TEX
13148	VOGUE INSTRUMENT CORP	COLLEGE POINT N Y
13209	BENDIX CORP THE SEMICONDUCTOR DIVISION	HOLMDEL N J
13327	SOLITRON DEVICES INC	NORWOOD N J
13440	AMERICAN PACKING AND GASKET CO	HOUSTON TEX
13550	ATLAS CONNECTORS CO	EL MONTE CALIF
13812	DIALCO ELECTRIC CORP	BROOKLYN NY
13850	TECHNIPOWER INC	SOUTH NORWALK, CONN.
13934	MIDWEC CORP	OSHKOSH NEBR
14193	CALIFORNIA RESISTOR CORP	SANTA MONICA, CALIF
14655	CORNELL-DUBILIER ELECTRIC CORP	NEWARK N J
14841	WARD LEONARD ELECTRIC CO	HAGERSTOWN MD
14869	RUSTRAK INSTRUMENT CO	MANCHESTER N H
14907	CRAMER DIV OF GIANNINI CONTROLS	OLD SAYBROOK, CONN.
15235	CROUSE-HINDS CO	SYRACUSE N Y
15481	CURTIN W H AND CO	HOUSTON, TEX
15605	CUTLER-HAMMER INC	MILWAUKEE WIS
15653	KAYLOCK DIVISION, KAYNAR MFG. CO.	FULLERTON, CALIF.
15801	FENWAL ELECTRONICS INC	FRAMINGHAM MASS
15909	DAVEN DIVISION THOMAS A EDISON INDUSTRIES MCGRAW EDISON CO	LIVINGSTON N J
16059	DEVCON CORP	DANVERS MASS
16089	MICRO-TEK	BATON ROUGE 70806
16129	CAPACITOR MOUNTING CLIP CORP	DALLAS TEX
16231	PARKER INSTRUMENT CORP	STAMFORD CONN
16332	MILWAUKEE RELAYS INC	CEDARBURG WIS
16352	COMPUTER DIODE CORP	LODI N J
16741	TRIAD TRANSFORMER CORP	HUNTINGTON IND
16959	DENNISON MANUFACTURING COMPANY	FARMINGHAM,MASS
17069	CIRCUIT STRUCTURES LAB	SANTA ANA CALIF
17276	NEXUS RESEARCH LABORATORY INC	CANTON MASS
17414	ROWAN CONTROLLER CO	RED BANK N J
18626	DRIVER HARRIS CO	HARRISON N J
18915	BIRTCHER CORP THE INDUSTRIAL DIVISION	MONTEREY PARK CALIF
19141	CAL-VAL R AND D CORP ISOMODE DIVISION	BURBANK, CALIF
19291	ECLIPSE FUEL ENGR CO	ROCKFORD ILL
19397	TRACOR INC	AUSTIN TEX
19701	ELECTRA MFG CO	INDEPENDENCE KANS
20512	SARGENT E H CO	SPRINGFIELD N J
21520	FANSTEEL METALLURGICAL CORP	NORTH CHICAGO ILL
21649	OTTO CONTROLS	MORTON GROVE ILL 60053
21926	GENERAL TECHNOLOGY CORP.	TORRANCE, CALIF
22893	SHELL CHEMICAL CO	PITTSBURG, CALIF
23050	PRODUCT COMPONENTS CORPORATION	HASTINGS-ON-HUDSON N Y
23732	TRACOR INC (SULZER DIV.)	ROCKVILLE,MD
25709	GOW MACK INSTRUMENT CO	MADISON N J
25795	GRAINGER W W INC	CHICAGO ILL
28520	HEYMAN MFG CO	KENILWORTH N J
29424	HOSKINS MFG CO	DETROIT MICH
30327	IMPERIAL EASTMAN CORP M	CHICAGO ILL
31356	J B T INSTRUMENTS INC	NEW HAVEN CONN
35529	LEEDS AND NORTHRUP	PHILADELPHIA PA
37942	MALLORY P R AND CO INC	INDIANAPOLIS IND
38056	MANNING MAXWELL AND MOORE DIV OF DRESSER IND INC	STRATFORD CONN
38443	MARLIN-ROCKWELL CORP	JAMESTOWN N Y
40920	MINIATURE PRECISION BEARINGS INC	KEENE N H
42190	MUTER CO	CHICAGO ILL
42498	NATIONAL CO INC	MALDEN MASS
44038	NORTH ELECTRIC CO	GALION OHIO
44655	OHMITE MFG CO	SKOKIE ILL
46384	PENN ENGINEERING AND MFG CORP	DOYLESTOWN PA
53629	SCIENTIFIC GLASS APPARATUS CO	BLOOMFIELD N J
55026	SIMPSON ELECTRIC CO	CHICAGO ILL
55814	SOLA ELECTRIC CO	ELK GROVE ILL
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MASS
56631	STANDARD ELECTRIC TIME CO	SPRINGFIELD MASS
58553	SUPERIOR VALVE AND FITTINGS CO	PITTSBURGH PA
59446	TELEX INC	ST PAUL MINN

NUMERIC LIST OF MANUFACTURER CODES

CODE NO.	MANUFACTURER	ADDRESS
59730	THOMAS AND BETTS CO	ELIZABETH N J
60741	TRIPLETT ELECTRICAL INSTRUMENT CO	BLUFFTON OHIO
63060	VICTOREEN INSTRUMENT CO	CLEVELAND OHIO
64484	WELCH SCIENTIFIC CO	CHICAGO ILLINOIS 60610
65092	WESTON INSTR. INC.	NEWARK N J
65586	WIEGAND EDWIN L CO	PITTSBURGH PA
70119	ADVANCE ELECTRIC AND RELAY CO	BURBANK CALIF
70269	ALLEGHENY LUDLUM STEEL CORP	PITTSBURGH, PA
70318	ALLMETAL SCREW PRODUCTS COMPANY INC	GARDEN CITY N Y
70331	ALPHA WIRE CORP	NEW YORK N Y
70563	AMPERITE CO	UNION CITY N J
70777	AUTOMATIC LOCKING DEVICES INC	BRIDGEPORT CONN
70884	BAYSTATE STAMPING CO	WORCESTER MASS
70903	BELDEN MFG CO	CHICAGO ILL
71002	BIRNBACH RADIO CO INC	NEW YORK N Y
71034	BLILEY ELECTRIC CO INC	ERIE PA
71218	BUD RADIO INC	WILLOUGHBY OHIO
71279	CAMBRIDGE THERMIONIC CORP	CAMBRIDGE MASS
71286	CAMLOC FASTNER CORP	PARAMUS N J 07652
71400	BUSSMAN MFG DIVISION OF MCGRAW-EDISON CO	ST LOUIS MO
71450	CTS CORP	ELKHART IND
71468	ITT CANNON ELECTRIC CO	LOS ANGELES CALIF
71482	CLARE C P AND CO	CHICAGO ILL
71590	CENTRALAB DIVISION OF GLOBE-UNION INC	MILWAUKEE WIS
71744	CHICAGO MINIATURE LAMP WORKS	CHICAGO ILL
71785	CINCH MFG CO AND HOWARD B JONES DIV	CHICAGO ILL
71984	DOW CORNING CORP	MIDLAND MICH
72136	ELECTRO MOTIVE MFG CO	WILLIMANTIC CONN
72259	NYTRONICS INC	BERKELEY HEIGHTS N J
72307	FAHNESTOCK ELECTRIC CO	LONG ISLAND CITY NY
72354	FAST JOHN E CO DIVISION OF VICTOREEN INSTRUMENT CO	CHICAGO ILL
72619	DIALIGHT CORP	BROOKLYN NY
72653	G C ELECTRONICS MFG CO	ROCKFORD ILL
72653	G C ELECTRONICS MFG CO	ROCKFORD ILL
72656	INDIANA GENERAL CORP ELECTRONICS DIVISION	KEASBY N J
72688	JOHN DOLPH CO	MONMOUNTH JUNCTION N J
72765	DRAKE MFG CO	CHICAGO ILL
72825	EBY HUGH H INC	PHILADELPHIA PA
72962	ELASTIC STOP NUT CORP OF AMERICA	UNION N J
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE PA
73138	HELIPOT DIVISION OF BECKMAN INSTRUMENTS INC	FULLERTON CALIF
73293	HUGHES PRODUCTS DIV OF HUGHES AIRCRAFT CO	NEWPORT BEACH CALIF
73445	AMPEREX ELECTRONIC CO DIV OF NORTH AMERICAN PHILIPS CO INC	HICKSVILLE N Y
73506	BRADLEY SEMICONDUCTOR CORP	HAMDEN CONN
73559	CARLING ELECTRIC INC	HARTFORD CONN
73734	FEDERAL SCREW PRODUCTS CORP	CHICAGO ILL
73803	METALS AND CONTROLS INC. DIV OF TI	ATTLEBORO, MASS
73899	J F D ELECTRONICS CORP	BROOKLYN N Y
73949	GUARDIAN ELECTRIC MFG CO	CHICAGO ILL
73977	HANDY AND HARMON	NEW YORK N Y
74042	MERIT COIL AND TRANSFORMER CORP	HOLLYWOOD FLORIDA
74199	QUAM NICHOLS CO	CHICAGO ILL
74440	HOBBS JOHN W CORP	SPRINGFIELD ILL
74545	HUBBELL HARVEY INC	BRIDGEPORT CONN
74840	ILLINOIS CONDENSER CO	CHICAGO ILL
74900	INTERNATIONAL NICKEL CO INC	NEW YORK N Y
74970	JOHNSON E F CO	WASECA MINN
75042	INTERNATIONAL RESISTANCE CO	PHILADELPHIA PA
75263	KEYSTONE CARBON CO INC	ST MARYS PA
75378	KNIGHTS JAMES CO THE	SANDWICH ILL
75582	LEVITON MFG CO	BROOKLYN N Y
75915	LITTELFUSE INC	DES PLAINES ILL
76381	MINNESOTA MINING AND MFG CO	ST PAUL, MINN
76487	MILLEN JAMES MFG CO INC	MALDEN MASS
76493	MILLER J W CO	LOS ANGELES CALIF
76545	MUELLER ELECTRIC CO	CLEVELAND OHIO
76854	OAK MFG CO	CRYSTAL LAKE ILL
77342	POTTER BRUMFIELD DIV OF AMF	PRINCETON IND
77342	AMERICAN MACHINE AND FOUNDRY CO POTTER AND BRUMFIELD DIV	PRINCETON IND
78189	SHAKEPROOF DIVISION OF ILLINOIS TOOL WORKS	ELGIN ILL
78277	SIGMA INSTRUMENTS INC	SO BRAINTREE MASS
78290	STRUTHERS-DUNN INC	PITMAN N J
78488	STACKPOLE CARBON CO	ST MARYS PA
78553	TINNERMAN PRODUCTS INC	CLEVELAND OHIO
78711	TELEPHONICS CORP	HUNTINGTON NY 11743
78947	UCINITE CO THE	NEWTONVILLE MASS
79061	VACO PRODUCTS INC	CHICAGO ILL
79136	WALDES KOHINOOR INC	LONG ISLAND CITY N Y
79142	VEEDER ROOT INC	HARTFORD CONN
79725	THE WIREMOLD CO	HARTFORD CONN
79727	CONTINENTAL-WIRT ELECTRONICS CORP	PHILADELPHIA PA
79963	ZIERICH MFGR CORP	NEW ROCHELLE, N. Y.
80145	ASSEMBLY PRODUCTS INC	CHESTERLAND OHIO
80223	UNITED TRANSFORMER CO	NEW YORK N Y
80294	BOURNS LABORATORIES INC	RIVERSIDE CALIF

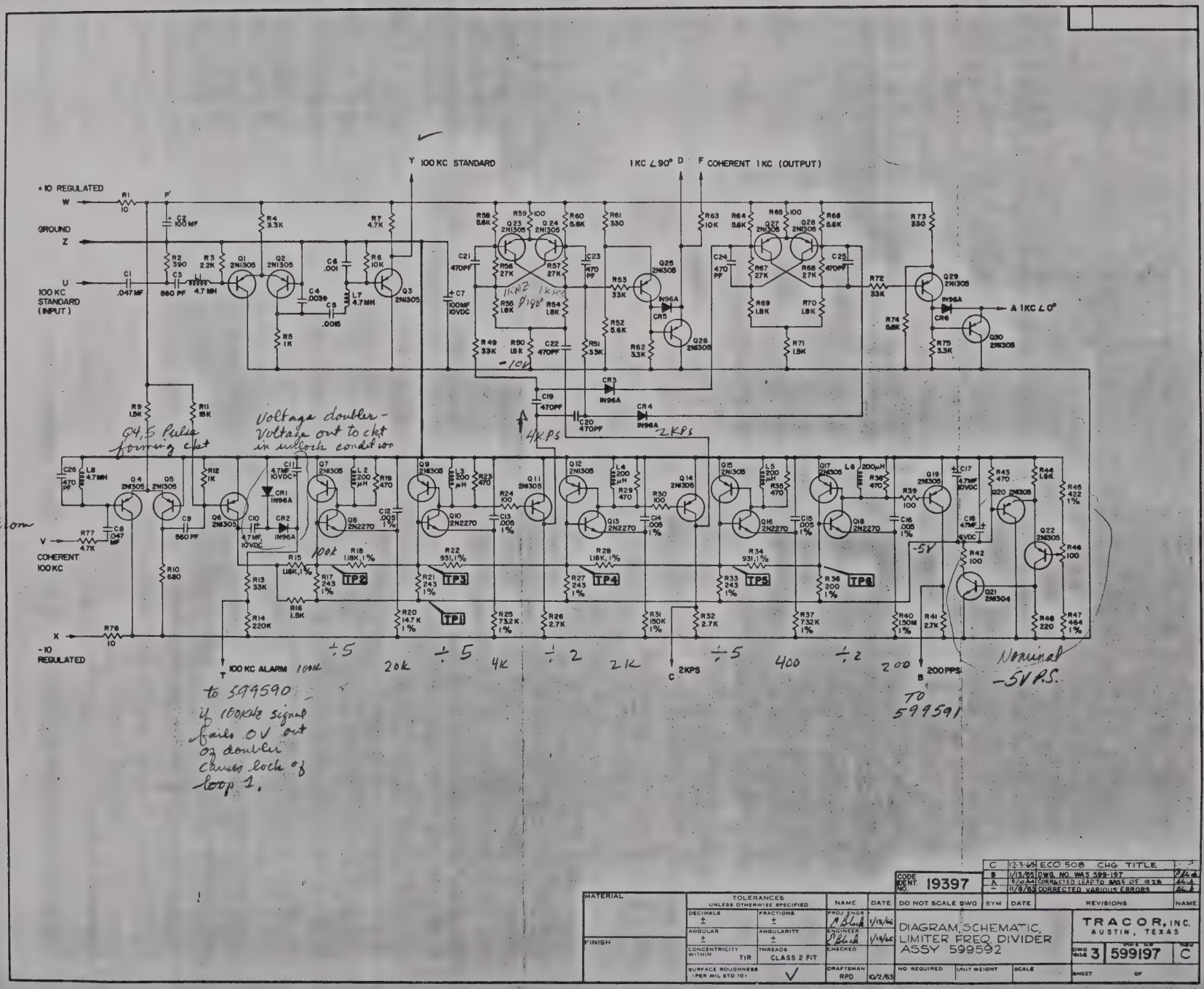
NUMERIC LIST OF MANUFACTURER CODES

CODE NO.	MANUFACTURER	ADDRESS
80583	HAMMARLUND CO INC	NEW YORK N Y
80640	STEVENS ARNOLD CO INC	BOSTON MASS
80813	DIMCO GRAY CO	DAYTON OHIO
80868	PHOTOCON RESEARCH PRODUCTS CO	PASADENA CALIF
81030	INTERNATIONAL INSTRUMENTS INC	ORANGE CONN
81073	GRAYHILL INC	LA GRANGE ILL
81095	TRIAD TRANSFORMER CORP	VENICE CALIF
81312	WINCHESTER ELECTRONICS CO INC	NORWALK CONN
81483	INTERNATIONAL RECTIFIER CORP	EL SEGUNDO CALIF
81640	CONTROLS COMPANY OF AMERICA	SELMA,NC
81812	TRIMM INC	LIBERTYVILLE ILL
81840	LEDEX INC	DAYTON OHIO
82227	HAYDON A W CO	WATERBURY CONN
82389	SWITCHCRAFT INC	CHICAGO ILL
82768	PHILLIPS-ADVANCE CONTROL CO DIV OF PHILLIPS-ECKARDT ELECT CORP	JOLIET ILL
82877	ROTRON MFG CO INC	WOODSTOCK N Y
82879	ROYAL ELECTIC CORP	PAWTUCKET,RHODE ISLAND
82893	VECTOR ELECTRONIC CO	GLENDALE CALIF
83008	STACO INC	DAYTON OHIO
83014	HARTWELL CORP	LOS ANGELES CALIF
83125	GENERAL INSTRUMENT CORP CAPACITOR DIVISION	DARLINGTON S C
83186	VICTORY ENGINEERING CO	SPRINGFIELD N J
83241	FUSITE CORP	CINCINATI OHIO
83330	SMITH HERMAN H INC	BROOKLYN N Y
83594	BURROUGHS CORP ELECTRONIC TUBE DIVISION	PLAINFIELD N J
83833	THOMAS AND SKINNER INC	INDIANAPOLIS IND
84171	ARCO ELECTRONICS INC	GREAT NECK N Y
84411	GOOD-ALL ELECTRIC MFG CO	OGALLALLA NEBR
84830	LEE SPRING CO.,, INC.	BROOKLYN,NEW YORK
84970	SARKES TARZIAN INC	BLOOMINGTON IND
84971	TA MFG CORP	LOS ANGELES CALIF 90039
86104	CELLUPLASTIC CORP	NEWARK N J
86335	GLENCO CORP	METUCHEN N J
86603	PROTECTION PRODUCTS MFG CO [WELDWOOD CEMENT]	KALAMAZOO, MICH
86797	ROGAN BROS	SKOKIE ILL
86928	SEASTROM MFG CO INC	GLENDALE CALIF 91201
87034	MARCO-OAK INDUSTRIES A DIV OF ELECTRO/NETICS CORP	ANAHEIM CALIF
87216	PHILCO CORP LANSDALE DIVISION	LANSDALE PA
87569	STEMCO CORP	CLEVELAND, OHIO
88145	IDEAL CORP	BROOKLYN N Y
88220	GOULD-NATIONAL BATTERIES INC	ST PAUL MINN
88245	U S ENGINEERING CO	VAN NUYS CALIF
88301	MYSTIK TYPE INC	NORTHFIELD, ILL
88499	STAYTITE PRODUCTS CO	CLEVELAND, OHIO
89469	BUCKEYE MOLDING CO	MIAMISBURG OHIO
89482	HOLTZER CABOT CORP	BOSTON MASS
89904	WESTINGHOUSE ELECTRIC CORP LAMP DIVISION	TRENTON N J
90052	BOSTON GEAR WORKS DIV OF MURRAY CO OF TEXAS	PHILADELPHIA PA
90095	TECHNITROL ENGINEERING CO	PHILADELPHIA PA
90634	GULTON INDUSTRIES INC	METUCHEN N J
90797	MAGNETICS INC	BUTLER PA
91407	SUPERIOR ELECTRIC CO THE	BRISTOL CONN
91506	AUGAT INC	ATTLEBORO MASS
91556	BROOKS INSTRUMENT DIV EMERSON ELECTRIC	HATFIELD PA
91637	DALE ELECTRONICS INC	COLUMBUS NEBR
91662	ELCO CORP	WILLOW GROVE PA
91767	HELI-COIL CORP	DANBURY CONN
91886	MALCO MFG CO	CHICAGO ILL
91927	MICRO METAL PRODUCTS INC	LOS ANGELES CALIF
91929	MINNEAPOLIS HONEYWELL MICROSWITCH DIV	FREEPORT ILL
92264	ENGINEERED PRODUCTS CO	FLINT MICHIGAN 48501
92966	HUDSON LAMP COMPANY	KEARNY N J
93308	CLARK ELECTRONICS LABORATORIES	PALM SPRINGS CALIF
93332	SYLVANIA ELECTRONICS DIV	WOBURN MASS 01801
93460	WHITE SS DENTAL MFG CO	PRINCE BAY STATEN ISLAND NY 10309
93908	CARLON PRODUCTS CORP	AURORA OHIO
93990	CLIMAX METAL PRODUCTS	CLEVELAND, OHIO
93994	CHART PAK INC	LEEDS MASS
94139	KEYSTONE ELECTRONICS CO	NEWARK N J
94144	RAYTHEON CO INDUSTRIAL COMPONENTS	QUINCY MASS
94222	SOUTH CHESTER CORP	CHESTER, PA
94310	TRU-OHM PRODUCTS MEMCOR COMPONENTS DIVISION	HUNTINGTON IND
94499	ALPHA MOLYKOTE CORP	STANFORD CONN
95146	ALCO ELECTRONICS MFG CO	LAWRENCE, MASS
95265	NATIONAL COIL CO	SHERIDAN WYO
95275	VITRAMON INC	BRIDGEPORT CONN
95348	GORDOS CORP	BLOOMFIELD N J
95354	METHODE MANUFACTURING CO	CHICAGO ILL
96341	MICROWAVE ASSOCIATES INC	BURLINGTON MASS
96467	SUPERIOR MFG AND INSTRUMENT CORP	LONG ISLAND CITY N Y
97464	INDUSTRIAL RETAINING RING CO	IRVINGTON N J
97539	A P M CORP	ENGLEWOOD N J
97814	SEALTRON CO	CINCINNATI OHIO
97852	STAR STAINLESS SCREW CO	PATTERSON N J
97954	U S COMPONENTS	NEW YORK N Y

CODE NO.	MANUFACTURER	ADDRESS
97965	STANCOR ELECTRONICS INC	CHICAGO ILL
98159	RUBBER TECK INC	GARDENA CALIF
98278	MICRODOT INC	SOUTH PASADENA CALIF
98291	SEALECTRO CORP	MAMARONECK N Y
98376	ZERO MFG CO	BURBANK CALIF
98911	ARMSTRONG PRODUCTS COMPANY	WARSAW INDIANA 56580
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP	BURBANK CALIF
98997	SIGHTMASTER CORP	PROVIDENCE,RHODE ISLAND
99114	HITEMP WIRES INC	WESTBURY N Y
99127	BALCO RESEARCH LABORATORIES	NEWARK N J
99378	ATLEE CORP	WINCHESTER MASS
99515	ELECTRON PRODUCTS (DIV OF MARSHALL INDUSTRIES)	SAN MARINO CALIF
99800	DELEVAN ELECTRONICS CORP	EAST AURORA N Y
99934	RENBRANDT INC	BOSTON MASS
99942	HOFFMAN ELECTRONICS CORP SEMICONDUCTOR DIVISION	EL MONTE CALIF
T0002	LANSDALE TRANSISTOR CORP	LANSDALE PA
T0003	PAMOTOR INC	SAN FRANCISCO CALIF
T0004	PATEK PHILIPPE	GENEVA, SWITZERLAND
T0005	RUSSELL INDUSTRIES INC	LYNBROOK, L. I., N. Y.
T0006	TRINITY CAPACITOR CO	TRINITY, TEXAS
T0007	SIEMENS AMERICA INC	WHITE PLAINS, N. Y.
T0009	MOLECU-WIRE CORP.	SCOBEYVILLE, ILL
T0010	PACTRA CHEMICAL CO INC	LOS ANGELES CALIFORNIA
T0011	EPCO	FLINT, MICH
T0012	DABURN ELECTRONICS AND CABLE CORPORATION	NEW YORK N Y
T0013	GRAYSON-STADLER	WEST CONCORD MASS
T0014	PEERLESS IMPERIAL CO	NEWARK N J
T0015	GENERAL PACKAGING CORP	DALLAS TEXAS
T0020	VICTOR WIRE AND CABLE CO	LOS ANGELES CALIF
T0021	UNIFORM TUBES INC	COLLEGEVILLE P A

IX. SCHEMATIC AND CIRCUIT DIAGRAMS

Dwg. No.	Title
599197	Limiter/Frequency Divider, Assy 599592
599198	VCO/Control Loop I, Assy 599590
599199	Control Loop II, Assy 599591
599200	Preset Counter, Assy 599589
599201	Receiver, Assy 599568
599392	Electronic Servo, Assy 599569
599393	AGC-Phase Unit, Assy 599626
599395	Electronic Servo, Assy 599394
599396	Electronic Servo, Assy 599570
599400	Connector Panel, Assy 599623
599553	Audio Converter and Amplifier, Assy 599552
599554	Synthesizer/Receiver/Recorder, Assy 599624
599726	Power Supply, Assy 599723



Ø shifted 100KHz from 599-402

to 599590 if 100KHz signal fails 0V out of doubler causes lock of loop 1.

TO 599591

C	12-3-65	ECO 508 CHG TITLE	
B	1/13/65	DWG. NO. WAS 599-197	
A	6/10/64	CORRECTED LEAD TO BASE OF Q28	
–	11/8/63	CORRECTED VARIOUS ERRORS	

CODE IDENT. NO. 19397

MATERIAL

FINISH

TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMALS ±; FRACTIONS ±; ANGULAR ±; ANGULARITY ±; CONCENTRICITY WITHIN TIR; THREADS CLASS 2 FIT; SURFACE ROUGHNESS PER MIL STD 10-; ✓

	NAME	DATE
PROJ ENGR	P Black	1/13/64
ENGINEER	P Black	1/14/64
CHECKED		
DRAFTSMAN	RPD	10/2/63

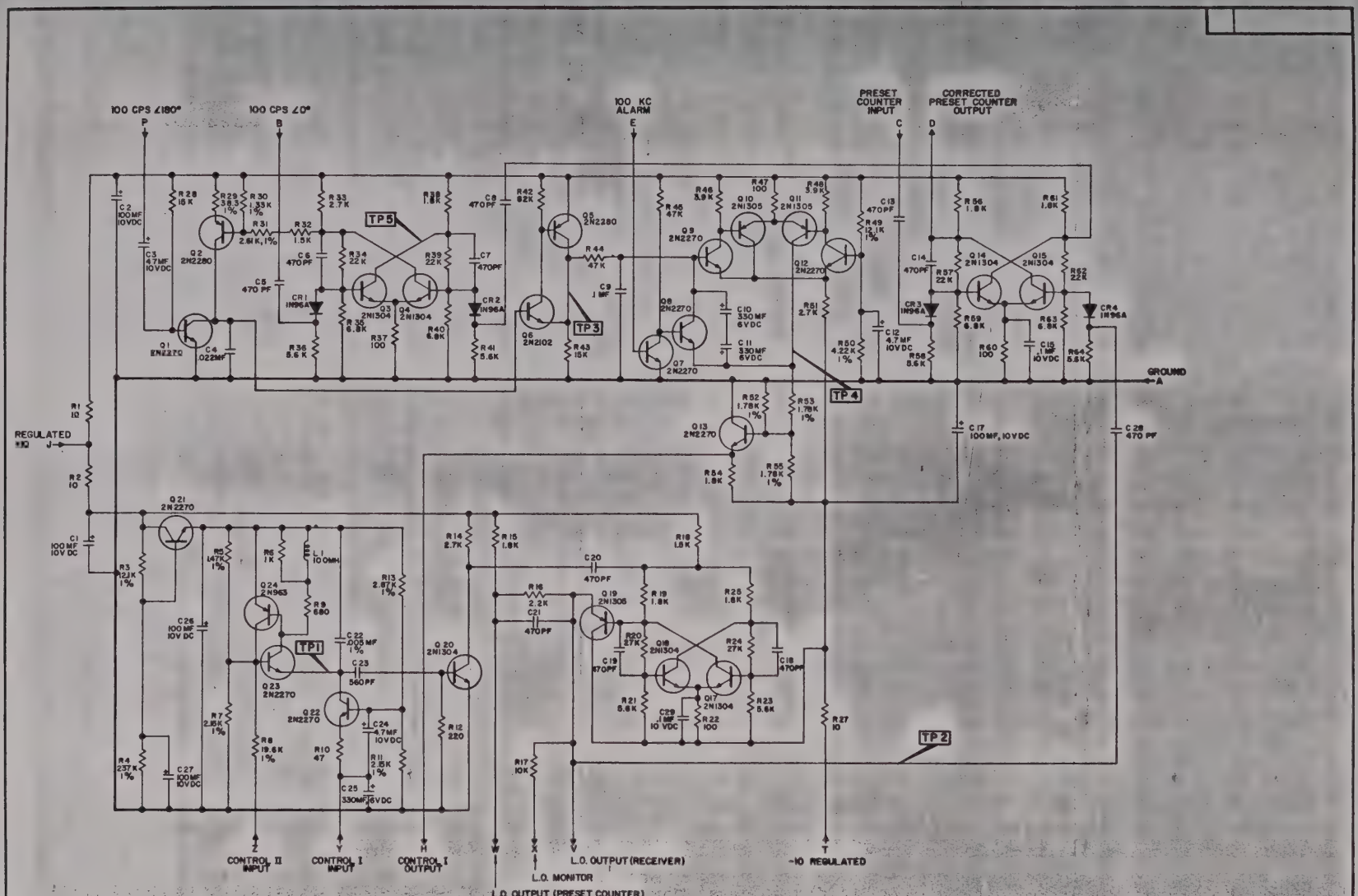
DO NOT SCALE DWG | NO REQUIRED | UNIT WEIGHT | SCALE

DIAGRAM, SCHEMATIC, LIMITER FREQ DIVIDER ASSY 599592

TRACOR, INC. AUSTIN, TEXAS

DWG SIZE 3 | DWG NO. 599197 | REV C

SHEET OF



D	2-3-65	ECO 908 CHG TITLE	
C	1/13/65	DWG. NO. WAS 599-198	
B	11-21-64	ADDED C29	
A	11/8/63	R42 WAS 105, Q6 WAS 2N2270	

CODE IDENT NO. 19397

MATERIAL

FINISH

TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMALS ±; FRACTIONS ±; ANGULAR ±; ANGULARITY ±; CONCENTRICITY WITHIN TIR; THREADS CLASS 2 FIT; SURFACE ROUGHNESS (PER MIL-STD-10) ✓

	NAME	DATE
PROJ ENGR	P Black	1/8/65
ENGINEER	P Black	1/8/65
CHECKED		
DRAFTSMAN	CB	10/1/63

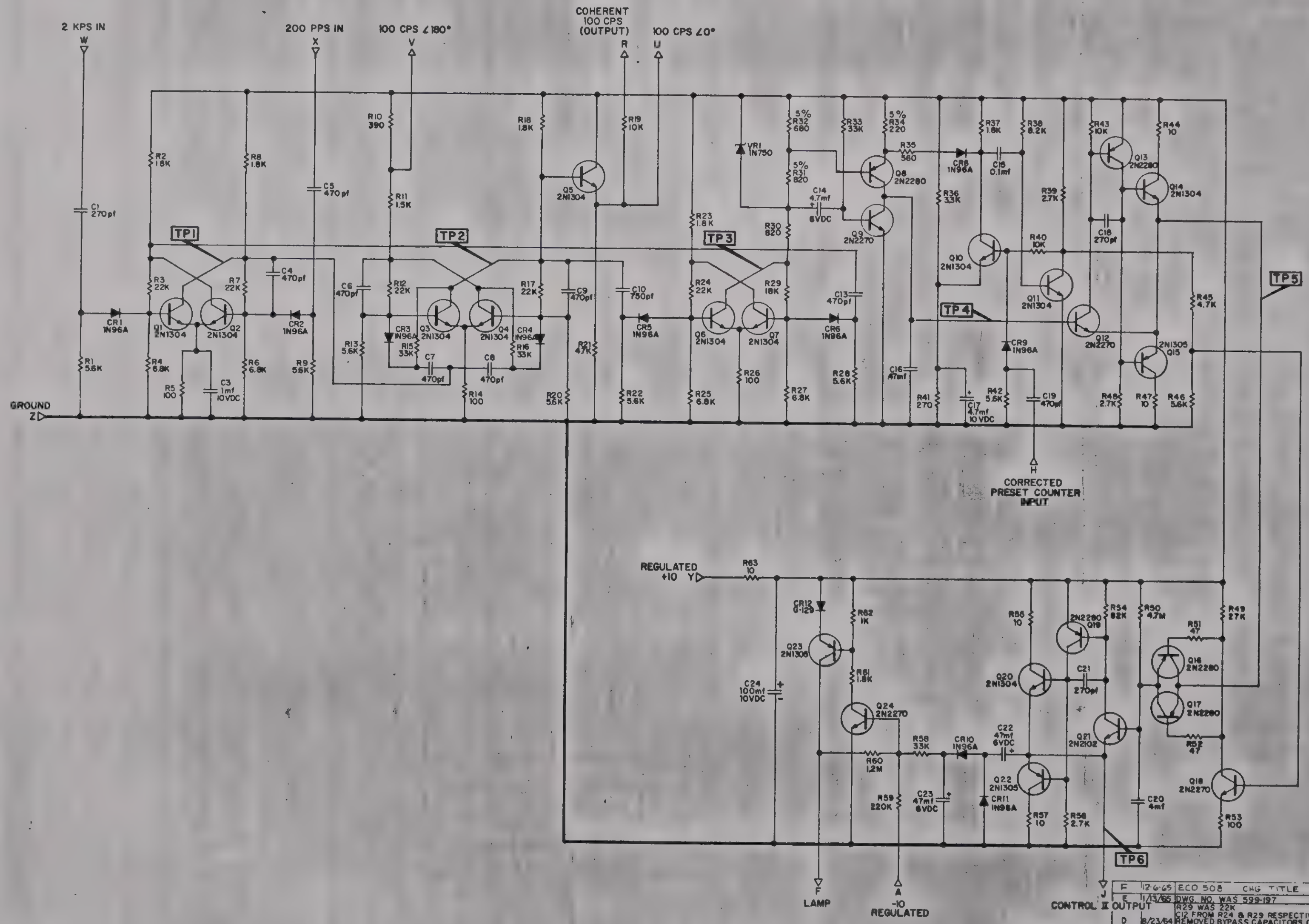
DO NOT SCALE DWG

DIAGRAM, SCHEMATIC, VCO/ CONTROL LOOP 1 ASSY 599590

TRACOR, INC. AUSTIN, TEXAS

SIZE D | DWG NO. 3 599198 | REV D

NO REQUIRED | UNIT WEIGHT | SCALE | SHEET OF



SYM	DATE	REVISIONS	NAME
F	12-6-65	ECO 508 CHG TITLE	
E	1/13/65	DWG. NO. WAS 599-197	E Block
D	8/23/64	R29 WAS 22K C12 FROM R24 & R29 RESPECTIVELY REMOVED BYPASS CAPACITORS C11 &	Block
C	12/10/63	R10 WAS 820, R11 WAS 1K, VR1 WAS CR7	Block
B	12/3/63	C10 WAS 470PF	Block
A	11/11/63	R54 WAS 10K Q21 WAS 2N2270, R50 WAS 2.2M.	Block

CODE IDENT NO. 19397

DO NOT SCALE DWG

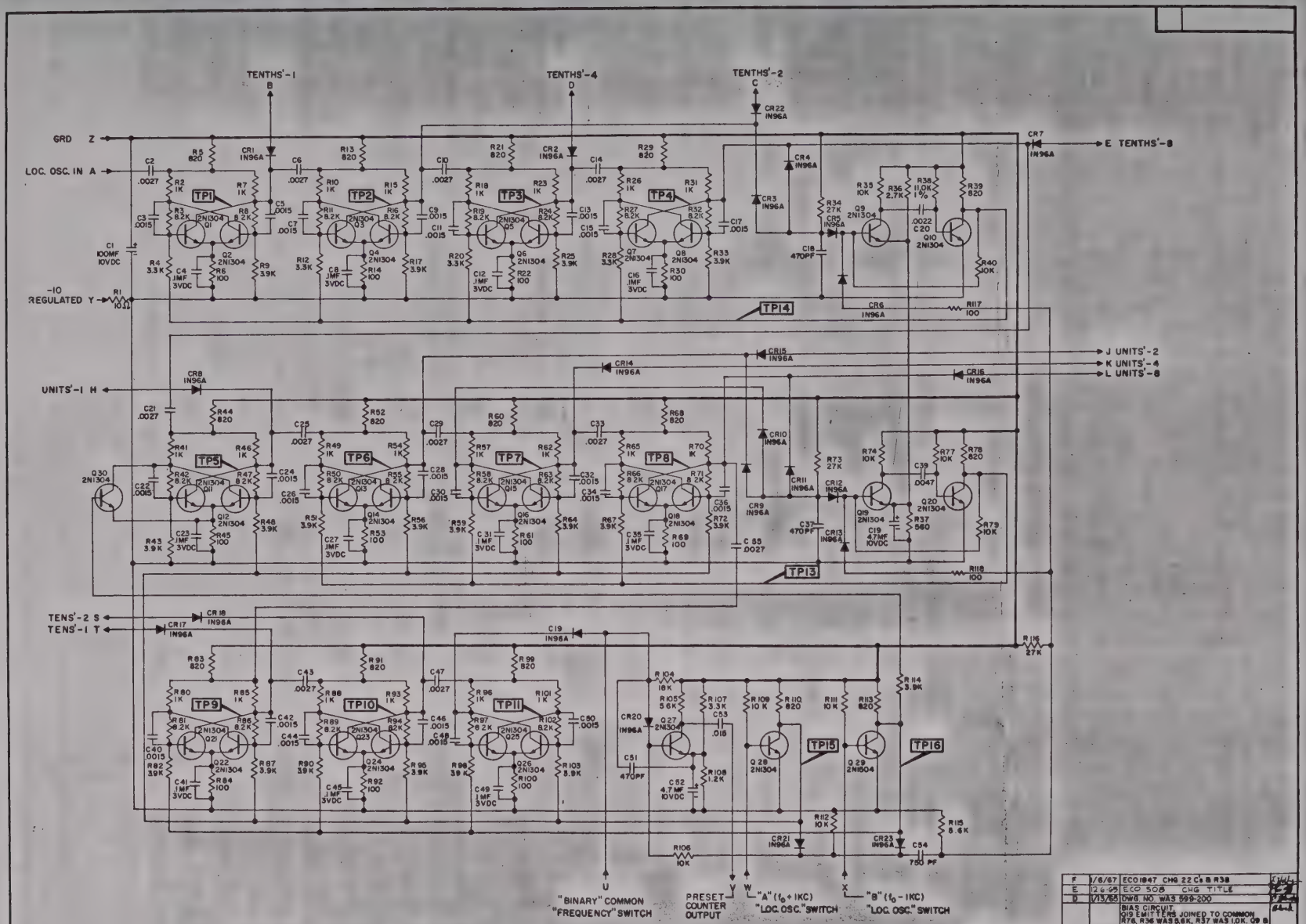
MATERIAL	TOLERANCES UNLESS OTHERWISE SPECIFIED		NAME	DATE
	DECIMALS ±	FRACTIONS ±	PROJ ENGR E Block	1/13/65
FINISH	ANGULAR ±	ANGULARITY ±	ENGINEER E Block	1/13/66
	CONCENTRICITY WITHIN TIR	THREADS CLASS 2 FIT	CHECKED	
	SURFACE ROUGHNESS PER MIL STD 10: √		DRAFTSMAN Hodgen	9 Oct 1963

DIAGRAM SCHEMATIC,
CONTROL LOOP 2
ASSY 599591

TRACOR, INC.
AUSTIN, TEXAS

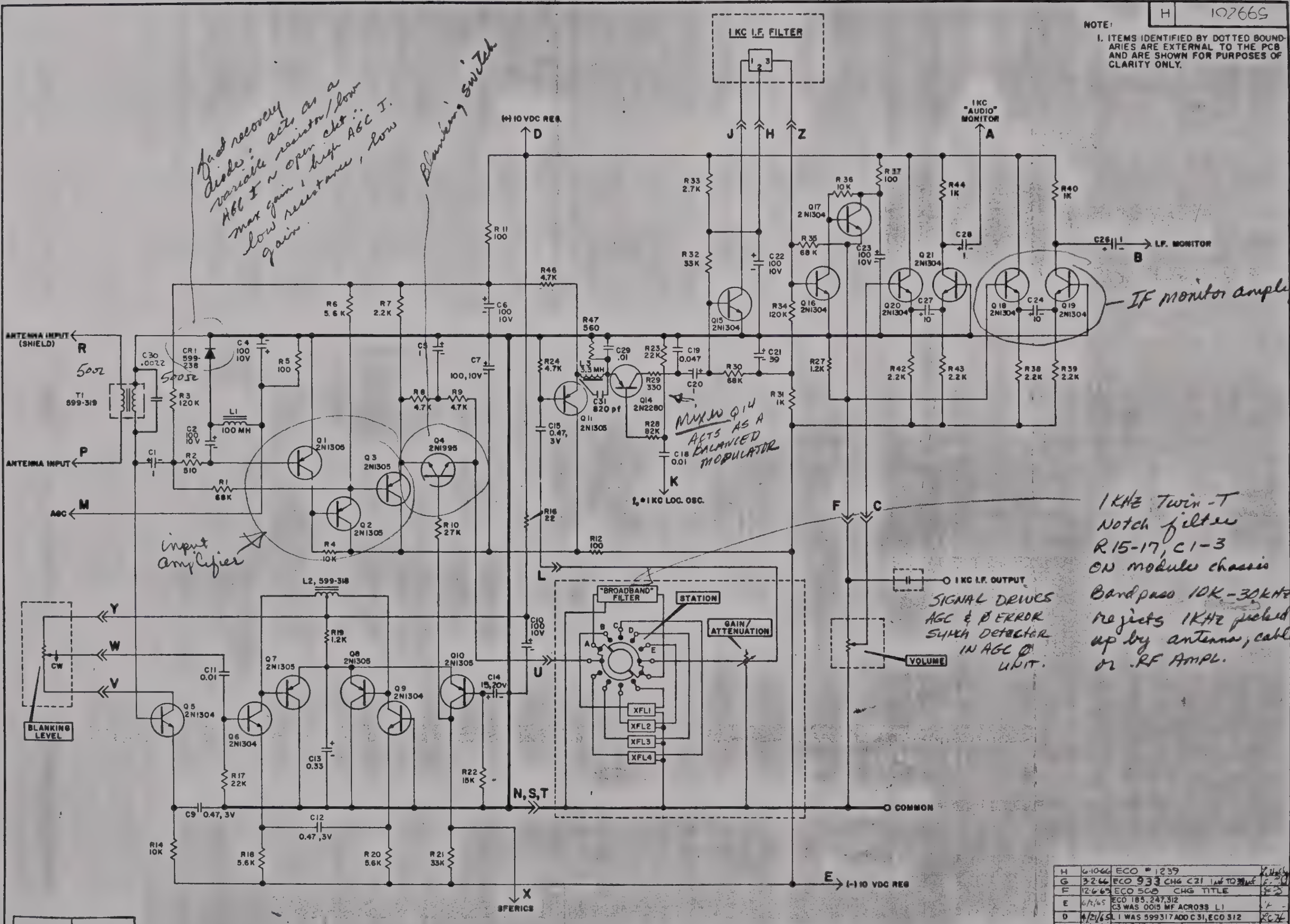
DWG SIZE 3 599199 REV F

NO REQUIRED | UNIT WEIGHT | SCALE | SHEET OF



F	1/6/67	ECO 1847 CHG 22 C & R38	
E	12-6-65	ECO 508 CHG TITLE	
D	1/13/65	DWG. NO. WAS 599-200	
C	1/15/64	BIAS CIRCUIT, Q19 EMITTERS JOINED TO COMMON, R76, R36 WAS 5.6K, R37 WAS 1.0K Q9 & ADDED R117 & R118 DELETED C36, R78 &	
B	12/19/63	R37 WAS 1.2K	
A	11/8/63	WENT TO BUS FROM Q20 COLLECTOR R4, R12, R20 & R28 WERE 3.3K, R43	

CODE IDENT NO. 19397	SYM	DATE	REVISIONS	NAME	
MATERIAL	TOLERANCES UNLESS OTHERWISE SPECIFIED	NAME	DATE	DO NOT SCALE DWG	TRACOR, INC. AUSTIN, TEXAS
FINISH	DECIMALS ± / FRACTIONS ±	PROJ ENGR	1/15/65	DIAGRAM, SCHEMATIC, PRESET COUNTER ASSY 599589	
	ANGULAR ± / ANGULARITY ±	ENGINEER	1/15/65		
	CONCENTRICITY WITHIN TIR / THREADS CLASS 2 FIT	CHECKED			
	SURFACE ROUGHNESS (PER MIL-STD-10) √	DRAFTSMAN CB	10/3/63	NO REQUIRED / UNIT WEIGHT / SCALE	DWG SIZE 3 599200 REV F
					SHEET OF


NOTE:
1. ITEMS IDENTIFIED BY DOTTED BOUNDARIES ARE EXTERNAL TO THE PCB AND ARE SHOWN FOR PURPOSES OF CLARITY ONLY.
1KC I.F. FILTER
(+) 10 VDC REG.
D
J
H
Z
1KC "AUDIO" MONITOR
A
I.F. MONITOR
B
ANTENNA INPUT (SHIELD)
R
ANTENNA INPUT
P
AGC
M
T1 599-319
CR1 599-238
Q1 2N1305
Q2 2N1305
Q3 2N1305
Q4 2N1995
Q5 2N1304
Q6 2N1304
Q7 2N1305
Q8 2N1305
Q9 2N1304
Q10 2N1305
Q11 2N1305
Q14 2N2280
Q15 2N1304
Q16 2N1304
Q17 2N1304
Q18 2N1304
Q19 2N1304
Q20 2N1304
Q21 2N1304
L1 100 MH
L2, 599-318
L3 3.3 MH
K
f, = 1 KC LOC. OSC.
F
C
1 KC I.F. OUTPUT
VOLUME
"BROADBAND" FILTER
STATION
GAIN/ ATTENUATION
XFL1
XFL2
XFL3
XFL4
L
U
Y
W
V
CW
BLANKING LEVEL
N,S,T
COMMON
X
SFERICS
E
(-) 10 VDC REG
fast recovery diode; acts as a variable resistor/low AGC I ≈ open ckt.: max gain; high AGC I. low resistance, low gain.
Blanking switch
input amplifier
MIXER Q14 ACTS AS A BALANCED MODULATOR
IF monitor amplifier
1KHz Twin-T Notch filter R15-17, C1-3 ON module chassis
Bandpass 10K-30KHz rejects 1KHz picked up by antenna, cable or RF Ampl.
SIGNAL DRIVES AGC & Ø ERROR SYNCH DETECTOR IN AGC Ø UNIT.

H 102665

SYM	DATE	REVISIONS	NAME
H	6-10-66	ECO # 1239	
G	3-2-66	ECO 933 CHG C21	
F	12-6-65	ECO 568 CHG TITLE	
E	6/1/65	ECO 185, 247, 312 C3 WAS .0015 MF ACROSS L1	
D	4/21/65	L1 WAS 599317 ADD C31, ECO 312	
C	3/1/65	ADD R47, C30 WAS C28, .047 ECO 247	
B	1/13/65	DWG. NO. WAS 599-201	
A	1/13/65	ADDED C28, C29 AND L3 ECO 185	
—	9/01/64	CLARIFIED LABELING OF Q8 & Q9	

19397

MATERIAL

FINISH

TOLERANCES UNLESS OTHERWISE SPECIFIED
DECIMALS ± | FRACTIONS ±
ANGULAR ± | ANGULARITY ±
CONCENTRICITY TIR | THREADS CLASS 2 FIT
SURFACE ROUGHNESS PER MIL-STD 10I ✓

	NAME	DATE
PROJ ENGR	C Black	1/13/65
ENGINEER	C Black	1/13/65
CHECKED		
DRAFTSMAN	Black	1/20/64

DO NOT SCALE DWG

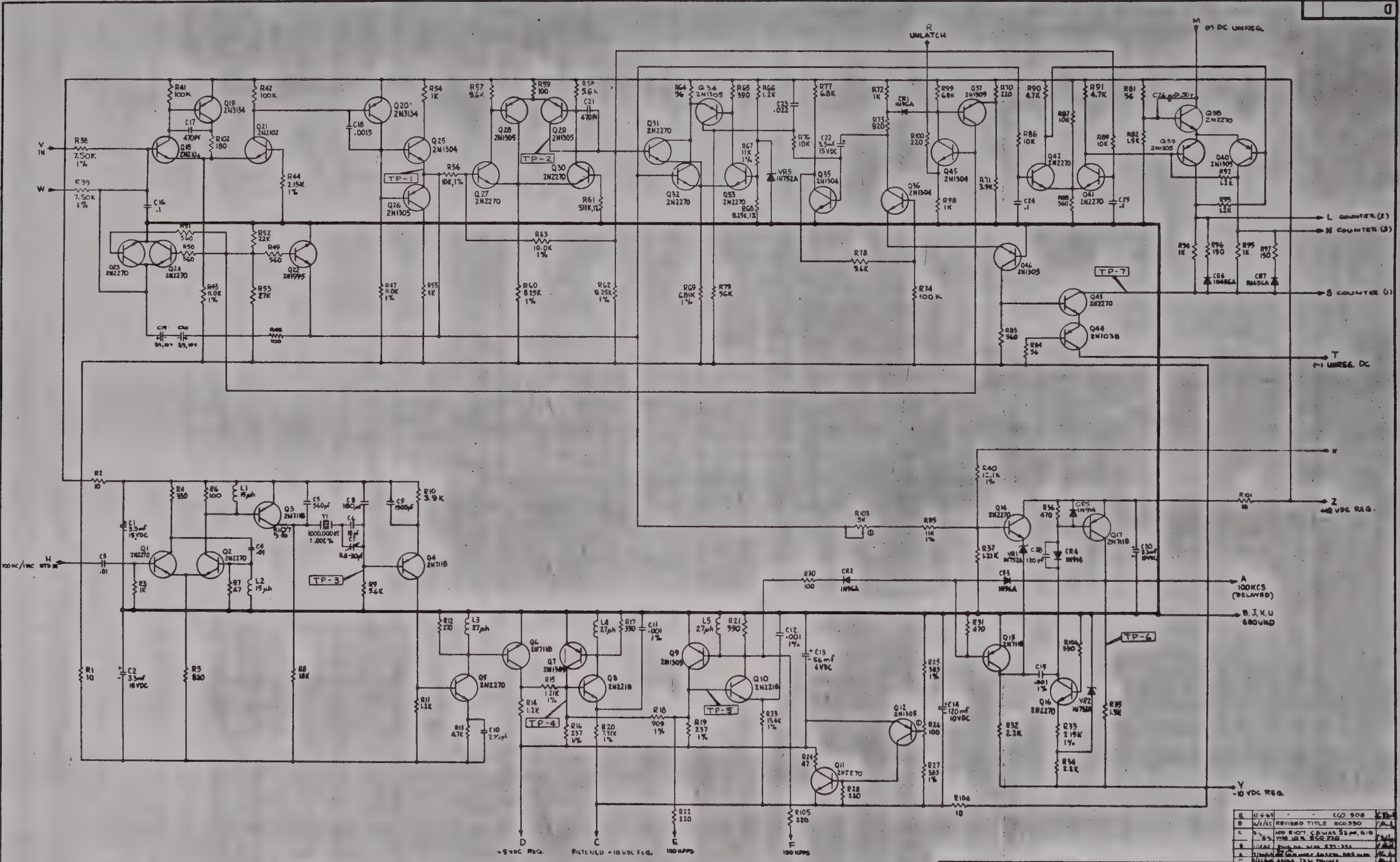
DIAGRAM, SCHEMATIC RECEIVER ASSY 599568

TRACOR, INC. AUSTIN, TEXAS

DWG SIZE 3 | DWG NO 599201 | REV H

NO REQUIRED | UNIT WEIGHT | SCALE | SHEET OF

ASSY. USED ON
APPLICATION



SYM	DATE	REVISIONS
E	12-6-69	" " ECO 908
D	6/2/65	REVISED TITLE ECO 390
C		ADD R107, C8 WAS 33pf, R10 WAS 10K ECO 770
B		DWG. NO. WAS 599-376
A		
—		

MATERIAL

FINISH

TOLERANCES UNLESS OTHERWISE SPECIFIED
DECIMALS ± FRACTIONS ±
ANGULAR ± ANGULARITY ±
CONCENTRICITY WITHIN TIR THREADS CLASS 2 FIT
SURFACE ROUGHNESS

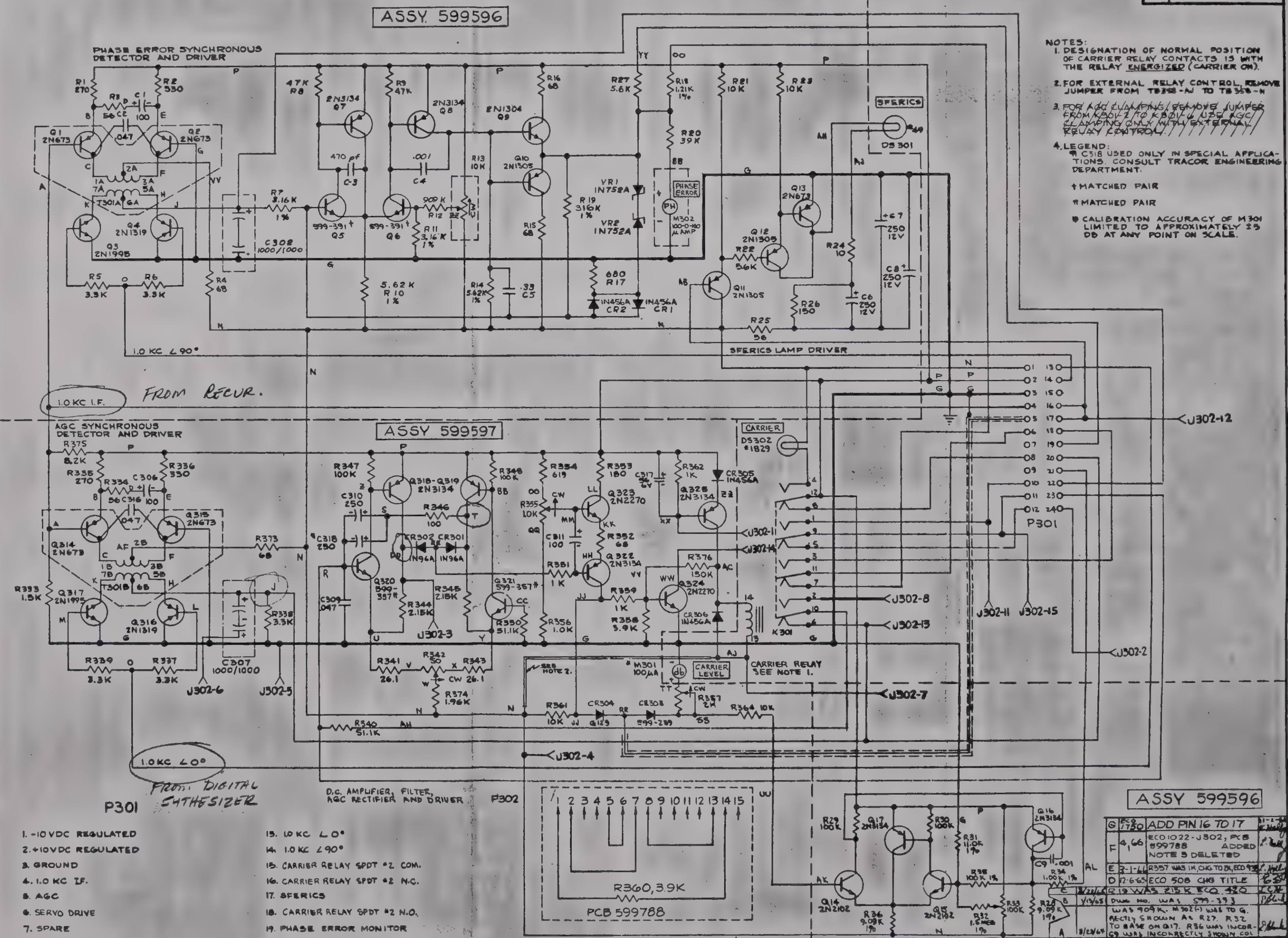
DO NOT SCALE DWG

DIAGRAM, SCHEMATIC, LO LIMITER/FILTER INTEGRATOR, ETC ASSY 599569

TRACOR, INC. AUSTIN, TEXAS

4 599392 E

599-300



NOTES:
1. DESIGNATION OF NORMAL POSITION OF CARRIER RELAY CONTACTS IS WITH THE RELAY ENERGIZED (CARRIER ON).
2. FOR EXTERNAL RELAY CONTROL, REMOVE JUMPER FROM TB358-N TO TB358-N
3. ~~FOR AGC CLAMPING, REMOVE JUMPER FROM K301-2 TO K301-6. USE AGC CLAMPING ONLY WITH EXTERNAL RELAY CONTROL.~~
4. LEGEND:
   - # C318 USED ONLY IN SPECIAL APPLICATIONS. CONSULT TRACOR ENGINEERING DEPARTMENT.
   - † MATCHED PAIR
   - ‡ MATCHED PAIR
   - ⊕ CALIBRATION ACCURACY OF M301 LIMITED TO APPROXIMATELY ±5 DB AT ANY POINT ON SCALE.

P301

1. -10VDC REGULATED
2. +10VDC REGULATED
3. GROUND
4. 1.0 KC I.F.
5. AGC
6. SERVO DRIVE
7. SPARE
8. SERVO DISABLE
9. SPARE
10. CARRIER RELAY SPDT #1 N.O.
11. CARRIER RELAY SPDT #1 COM.
12. CARRIER RELAY SPDT #1 N.C.
13. 1.0 KC ∠0°
14. 1.0 KC ∠90°
15. CARRIER RELAY SPDT #2 COM.
16. CARRIER RELAY SPDT #2 N.C.
17. SFERICS
18. CARRIER RELAY SPDT #2 N.O.
19. PHASE ERROR MONITOR
20. CARRIER LEVEL (UNFILTERED) MONITOR
21. CARRIER LEVEL (OUTPUT)
22. TEST POINT (FACTORY USE)
23. TEST POINT (FACTORY USE)
24. RELAY CONTROL. SEE NOTE NO. 2

SYM	REVISIONS	DATE	NAME
G	ECO 1730 ADD PIN 16 TO 17		
F	ECO 1022-J302, PCB 599788 ADDED. NOTE 3 DELETED	4-66	
E	R357 WAS 1K, CHG TO 2K, ECO 958	3-1-66	
D	ECO 508 CHG TITLE	12-6-65	
C	R19 WAS 215K ECQ 430		
B	DWG NO. WAS 599-393. R34 WAS 909K, M302(-) WAS TO G. RECTIFY SHOWN AS R27. R32 TO BASE ON Q17. R36 WAS INCORRECTLY SHOWN. C9 WAS INCORRECTLY SHOWN. COL.	9/15/65	
A		8/24/65	

MATERIAL	TOLERANCES (UNLESS OTHERWISE SPECIFIED)		NAME	DATE	
	DECIMALS ±	FRACTIONS ±	PROJ. ENGR.	1/15/65	DIAGRAM, SCHEMATIC, AGC PHASE MODULE, ASSY 599626
	ANGULAR ±	ANGULARITY ±	ENGINEER	1/15/65	DO NOT SCALE DWG
FINISH	CONCENTRICITY WITHIN TIR	THREADS CLASS 2 FIT	CHECKED	8/1/64	
	SURFACE ROUGHNESS (PER MIL-STD-10) ✓		DRAFTSMAN	7/1/64	NO. REQUIRED / UNIT WEIGHT / SCALE

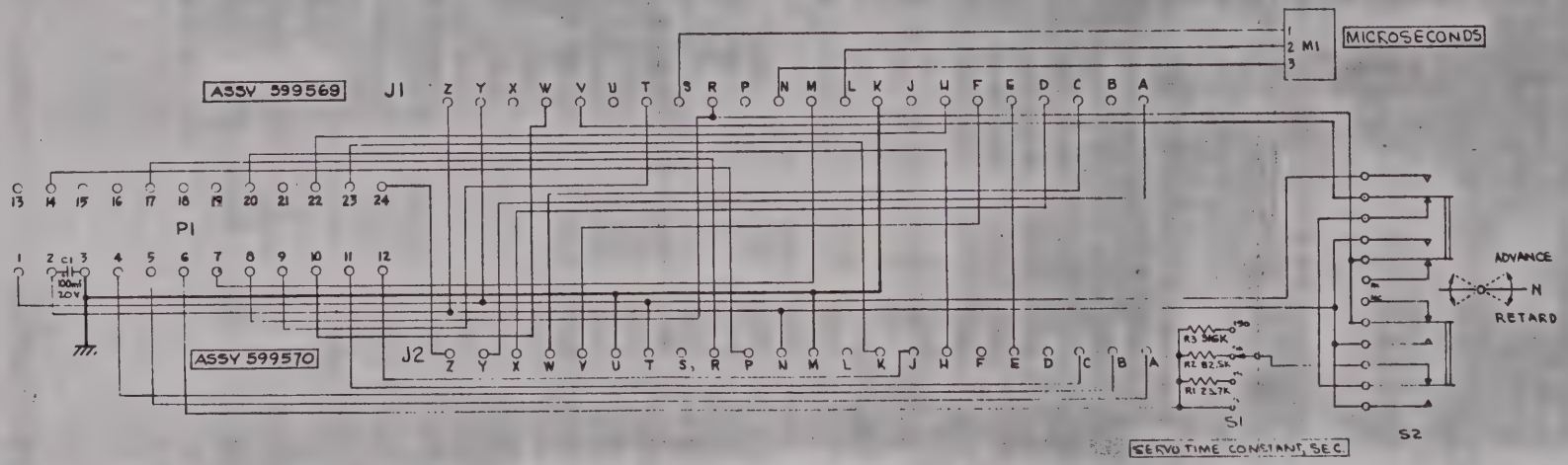
CODE IDENT NO 19397

TRACOR, INC. AUSTIN, TEXAS

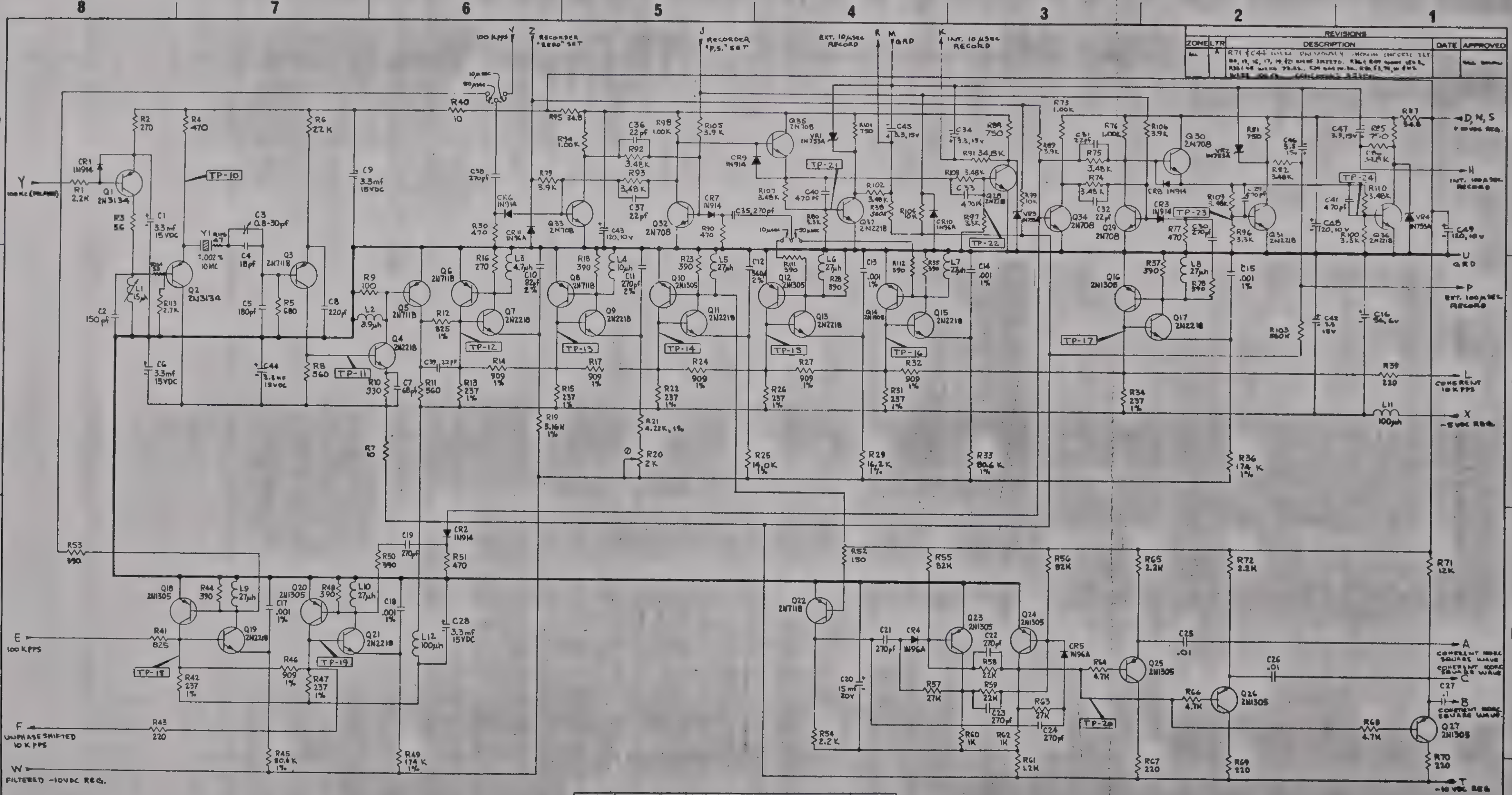
SIZE 3 — DWG NO. 599393 — G

SHEET 1 OF 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
B4	A	LEADS TO P1-4 & 5 WERE REVERSED	8/23/64	[illegible]
	B	DWG. NO. WAS 599-395	9/13/65	[illegible]
A1	C	ECO 508 CHG TITLE	12-6-65	[illegible]
B3	D	ECO 1075 ADDED CONNECTION J1-W TO P1-10	4-4-66	[illegible]
B1	E	R3 WAS 267K PER ECO 1745	10/14/66	[illegible]



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWINGS		TRACOR, INC. AUSTIN, TEXAS	
		TOLERANCES		DIAGRAM, SCHEMATIC, PHASE SERVO MODULE.	
		DECIMALS / FRACTIONS / ANGLES	ENGINEER [illegible] 1/13/65		
		MATERIAL:	CHECKED [illegible] 4/14/66		
	599H		DRAFTSMAN PERRY [illegible]		
599394	599G			SIZE 3 / CODE IDENT NO. 19391 / DWG NO. 599395 / 1	
NEXT ASSY	USED ON			SCALE	SHEET 1 OF 1
APPLICATION					



ZONE	LTR	DESCRIPTION	DATE	APPROVED
A-3 & A-1	H	TITLE CHG; APPLICATIONS ADDED PER ECO 465	3-1-66	L. Holly
A-1	G	ECO 508 CHG TITLE	12-6-65	[illegible]
4D & 2C	F	R38 & R103 WERE 1 MEG - ECO 392	7/14/65	L. Holly
—	E	TITLE WAS ALSO REVISED ECO 314 (VR3, VR4, & R113 CORRECTED.) CORRECTED CHANGES PREVIOUSLY MADE PER	6/2/65	[illegible]
—	D	ADD R114 & R115, R10 WAS 560 (ECO 314) Q1 & Q2 WERE 2N711B, R4 WAS 1K, R6 WAS 39K. ADDED VR3 & VR4, R86 & R91 68.1K; [illegible]	4/21/65	L. Holly
—	C	DWG. NO. WAS 599-396.	1/13/65	[illegible]
—	B	ADDED VR1 & VR2. R82 & R102 WERE 6.81K ECO # 184	1/12/65	[illegible]
ALL	A	WERE SHOWN CORRECTLY. WERE 270 PF. R25 WAS 15 [illegible] R82, [illegible] CONNECTIONS [illegible]	9/1/64	[illegible]

REVISIONS (CONTINUED)

NEXT ASSY	USED ON
599570	599 H
599570	599 G

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWINGS

TOLERANCES: DECIMALS | FRACTIONS | ANGLES

MATERIAL:

ENGINEER	E. Black	1/13/65
CHECKED	M. Mar	2/28/66
DRAFTSMAN	Black	7/12/64

TRACOR, INC. AUSTIN, TEXAS

DIAGRAM, SCHEMATIC, PHASE SHIFTERS, PHASE COMPARATOR, ASSY. 599570

SIZE 4 | CODE IDENT NO 19397 | 599396 | H

SCALE — | SHEET 1 OF 1

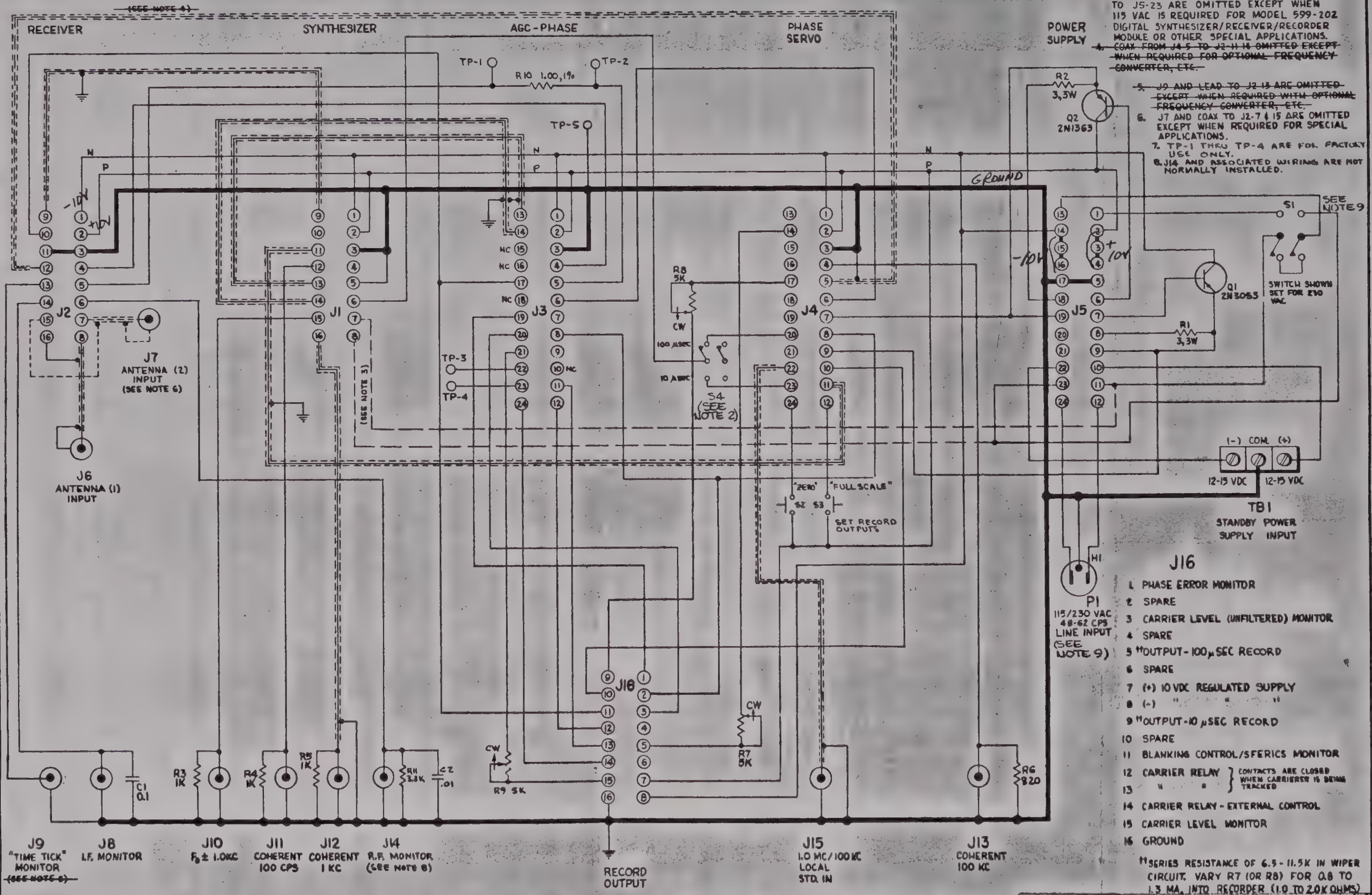
C 599400 F

NOTES:

1. ARRANGEMENT OF J1 THROUGH J5 IS AS VIEWED FROM THE REAR OF THE CONNECTORS.
2. S4 AND ASSOCIATED WIRING ARE OMITTED EXCEPT WHEN REQUIRED FOR INTERNAL RECORDER IN MODEL 599H RECEIVERS.
3. LEADS FROM J1-7 TO J5-11 AND FROM J1-8 TO J5-23 ARE OMITTED EXCEPT WHEN 115 VAC IS REQUIRED FOR MODEL 599-202 DIGITAL SYNTHESIZER/RECEIVER/RECORDER MODULE OR OTHER SPECIAL APPLICATIONS.
4. ~~COAX FROM J4-5 TO J2-11 IS OMITTED EXCEPT WHEN REQUIRED FOR OPTIONAL FREQUENCY CONVERTER, ETC.~~
5. ~~J9 AND LEAD TO J2-13 ARE OMITTED EXCEPT WHEN REQUIRED WITH OPTIONAL FREQUENCY CONVERTER, ETC.~~
6. J7 AND COAX TO J2-7 & 15 ARE OMITTED EXCEPT WHEN REQUIRED FOR SPECIAL APPLICATIONS.
7. TP-1 THRU TP-4 ARE FOR FACTORY USE ONLY.
8. J14 AND ASSOCIATED WIRING ARE NOT NORMALLY INSTALLED.

NOTES CONTINUED

9. S1 AND ASSOCIATED WIRING IS OMITTED AND JUMPERS ARE INSTALLED FROM J5-1 TO J5-2 AND FROM J5-13 TO J5-14 WHEN THE POWER SUPPLY HAS A 115 VAC TRANSFORMER ONLY.



J16

1. PHASE ERROR MONITOR
2. SPARE
3. CARRIER LEVEL (UNFILTERED) MONITOR
4. SPARE
5. *OUTPUT-100 µSEC RECORD
6. SPARE
7. (+) 10 VDC REGULATED SUPPLY
8. (-) " " "
9. *OUTPUT-10 µSEC RECORD
10. SPARE
11. BLANKING CONTROL/SFERICS MONITOR
12. CARRIER RELAY } CONTACTS ARE CLOSED WHEN CARRIER IS BEING TRACKED
13. " "
14. CARRIER RELAY - EXTERNAL CONTROL
15. CARRIER LEVEL MONITOR
16. GROUND

*SERIES RESISTANCE OF 6.5 - 11.5K IN WIPER CIRCUIT. VARY R7 (OR R8) FOR 0.8 TO 1.3 MA. INTO RECORDER (1.0 TO 2.0K OHMS)

SYM	DATE	REVISIONS	NAME
F	5/25/66	ECO 1234 ADDED NOTE 9	
E	4-66	ECO 1075 ADDED CONN. J4-8 TO J16-2, J4-10 TO J16-10	
D	12-6-65	ECO 508 CHG TITLE	
C	9/1/65	TIME TICK OUTPUT MADE STD. NOTES 4 & 5 DELETED. ECO 197	APO.
B	1/5/65	DWG. NO. WAS 599-400	
A	2/11/65	R6 WAS 1K, Q1 WAS 2N1218	

CODE IDENT NO. 19397

MATERIAL

FINISH

TOLERANCES UNLESS OTHERWISE SPECIFIED		
DECIMALS ±	FRACTIONS ±	
ANGULAR ±	ANGULARITY ±	
CONCENTRICITY WITHIN TIR	THREADS CLASS 2 FIT	
SURFACE ROUGHNESS (PER MIL STD-10)	√	

	NAME	DATE
PROJ ENGR		1/15/65
ENGINEER		1/15/65
CHECKED		1/16/65
DRAFTSMAN	PERRY	

DO NOT SCALE DWG

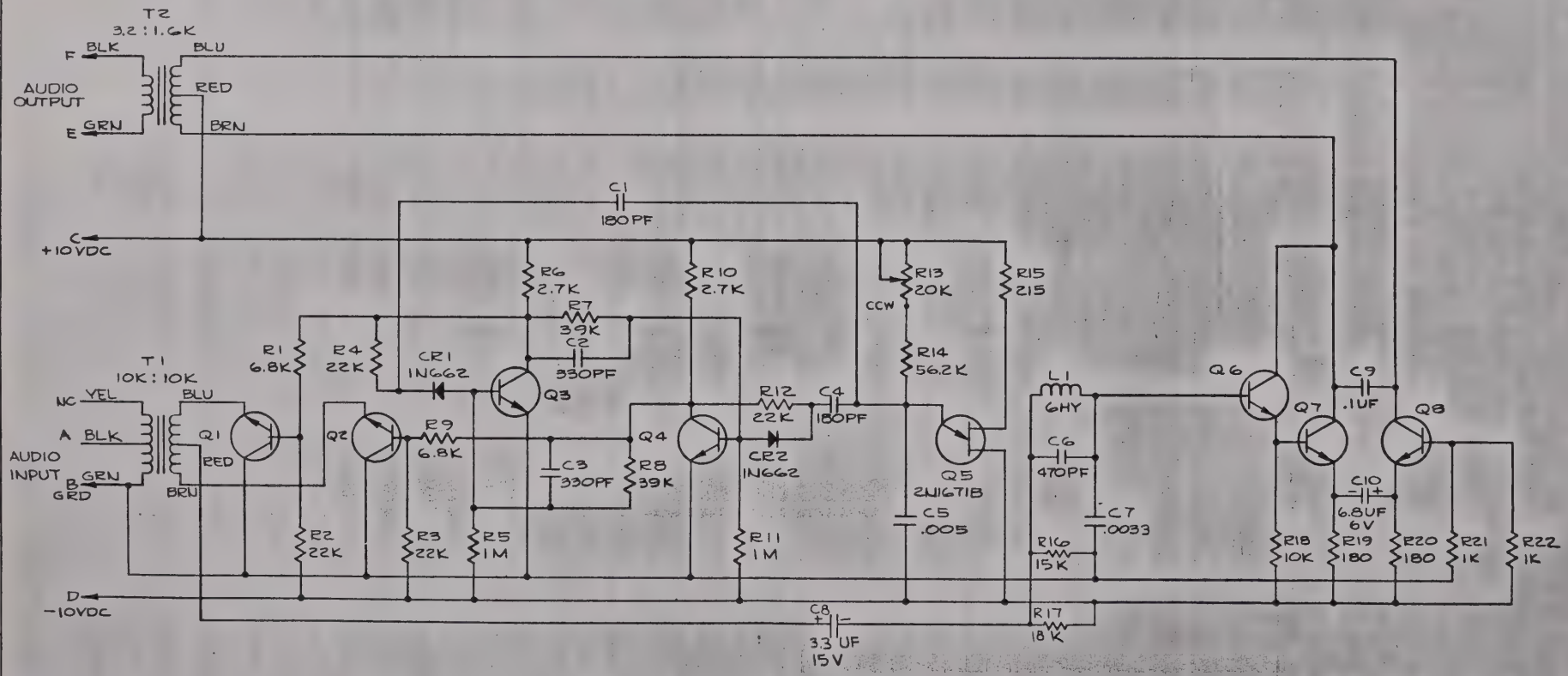
DIAGRAM, SCHEMATIC, CONNECTOR PANEL

TRACOR, INC. AUSTIN, TEXAS

DWG SIZE 3 599400 F

NO REQUIRED | UNIT WEIGHT | SCALE — | SHEET 1 OF 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	X1	RELEASED		
	A	ON T1, A-BLK & NC YEL WERE INTERCHANGED. R16 WAS 220K, R17 WAS 120K; R16 & 17 WERE ON OUTPUT OF FILTER. C7 WAS .0039; C10 WAS 3.3 MFD; C8 WAS ADDED. COLLECTOR OF Q6 WAS TO H10		
A1	B	ECO 508 CHG TITLE		



NOTES:
1. ALL TRANSISTORS ARE 2N2270 UNLESS OTHERWISE SPECIFIED.

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWINGS

TOLERANCES

DECIMALS	FRACTIONS	ANGLES
~	~	~

MATERIAL: ~

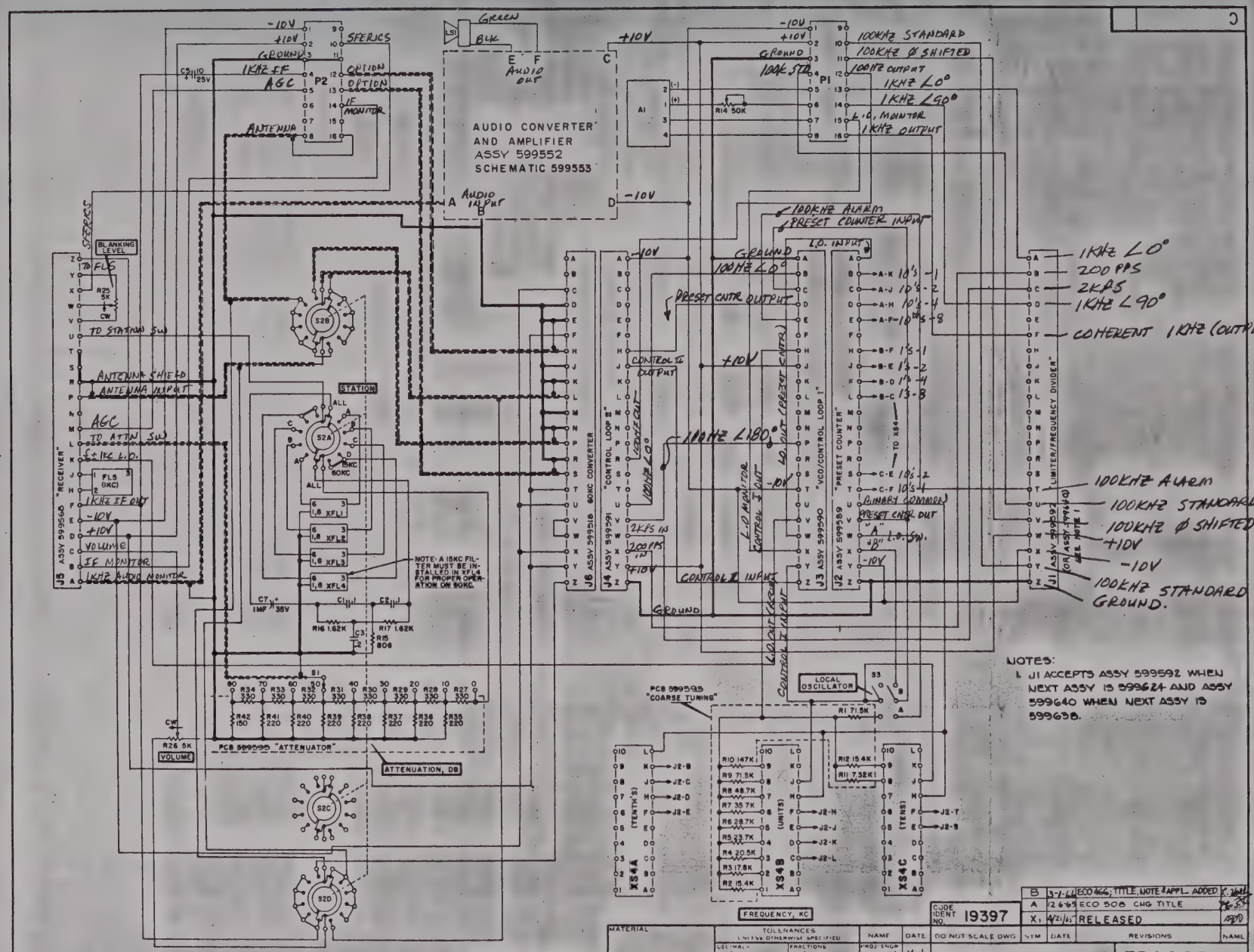
ENGINEER	L. Holly	4/21/65
CHECKED	WRS	4 21 65
DRAFTSMAN	Walton	4-19-65

TRACOR, INC. AUSTIN, TEXAS

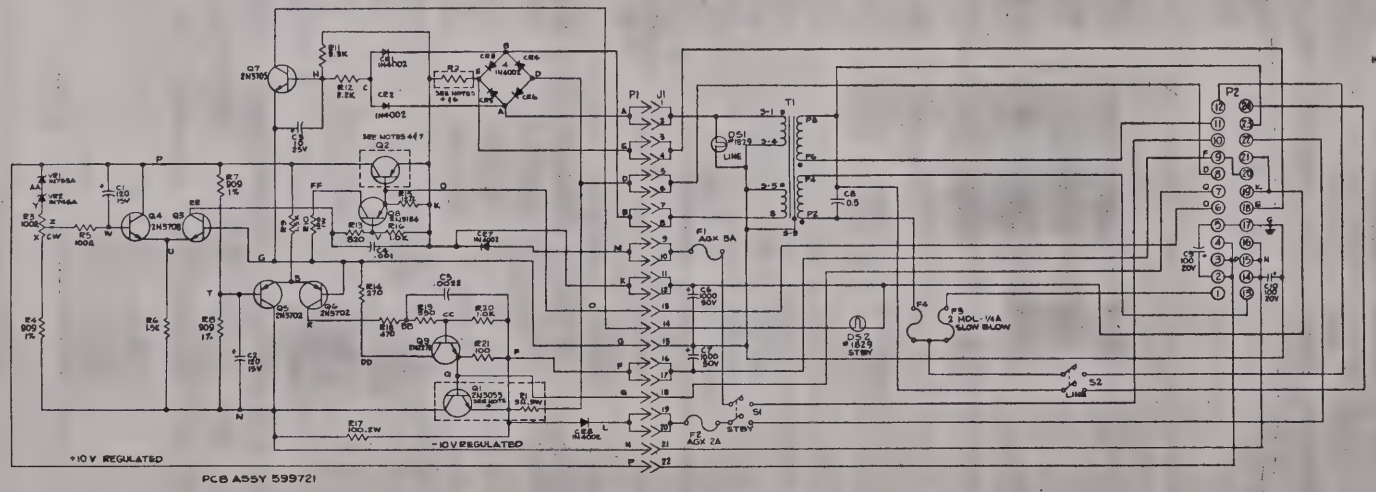
DIAGRAM, SCHEMATIC
AUDIO CONVERTER & AMPLIFIER
ASSY 599552

SIZE	CODE IDENT NO.		
3		599553	B

SCALE ~ SHEET ~ OF ~


AUDIO CONVERTER AND AMPLIFIER ASSY 599552 SCHEMATIC 599553
"RECEIVER"
"CONTROL LOOP 2"
"CONTROL LOOP 1"
"PRESET COUNTER"
"VCO/CONTROL LOOP 1"
LIMITER/FREQUENCY DIVIDER
"ATTENUATOR"
"COARSE TUNING"
LOCAL OSCILLATOR
ATTENUATION, DB
FREQUENCY, KC
1KHz ∠0°
200 PPS
2KPS
1KHz ∠90°
COHERENT 1KHz (OUTPUT)
100KHz ALARM
100KHz STANDARD (INPUT)
100KHz Ø SHIFTED FROM 599-902
+10V
-10V
100KHz STANDARD GROUND.
NOTE: A 15KC FILTER MUST BE INSTALLED IN XFL4 FOR PROPER OPERATION ON 60KC.
NOTES:
1. J1 ACCEPTS ASSY 599592 WHEN NEXT ASSY IS 599624 AND ASSY 599640 WHEN NEXT ASSY IS 599638.
599638 599H
599624 599H
NEXT ASSY USED ON
APPLICATION
B 3-1-64 ECO 466, TITLE, NOTE 4 APPL. ADDED
A 12-6-63 ECO 508 CHG TITLE
X1 4/21/63 RELEASED
CODE IDENT NO. 19397
DO NOT SCALE DWG
REVISIONS
TRACOR, INC AUSTIN, TEXAS
DIAGRAM, SCHEMATIC, RECEIVER/SYNTHESIZER RECORDER MODULE
DWG NO. 599554
SIZE B
SHEET 3 OF

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	X1	RELEASED	7-21-66	



PCB ASSY 599721

NOTES

1. ALL RESISTOR VALUES IN OHMS AND ARE 1/2W, 10%, UNLESS OTHERWISE NOTED.
2. ALL CAPACITOR VALUES IN MICROFARADS.
3. Q6 IS MOUNTED IN HEATSINK.
4. COMPONENTS ENCIRCLED WITH DASHED LINES ARE LOCATED ON BACK PANEL OF RECEIVER.
5. THE LAST USED REFERENCE DESIGNATORS ARE R21, C10, Q9, CR8, VR2, P1, J2, F4, DS2 AND S2.
6. R2 IS 30, 3W FOR 599 G & H RECEIVERS AND IS 1A, 3W FOR 599 J & K RECEIVERS (LOCATED ON RCVR REAR PANEL - NOT A PART OF POWER SUPPLY MODULE).
7. Q2 IS 2N1343 FOR 599 G & H RECEIVERS AND IS 2N1539 FOR 599 J & K RECEIVERS (LOCATED ON RCVR REAR PANEL - NOT A PART OF POWER SUPPLY MODULE).

P2

1. A C LINE - FUSED ("HI" SIDE)
2. (+) 10VDC REGULATED
3. (+) 10VDC REGULATED
4. (+) 10 VDC REGULATED
5. GROUND
6. CONTROL: (+) SUPPLY REGULATOR
7. CONTROL: (-) SUPPLY REGULATOR
8. (-) 18V FULL WAVE RECTIFIED
9. (-) 15VDC UNREGULATED
10. (+) 12VDC STANDBY POWER IN
11. 115 VAC INTERNAL ("HI" SIDE)
12. 115/230 VAC LINE. (115 VAC "HI" SIDE)
13. 115/230 VAC SELECTOR
14. (-) 10 VDC REGULATED
15. (-) 10 VDC REGULATED
16. (-) 10 VDC REGULATED
17. GROUND
18. (+) 18V FULL WAVE RECTIFIED
19. (+) 15VDC UNREGULATED
20. (-) 15VDC UNREGULATED
21. (+) 15VDC UNREGULATED
22. (-) 12VDC STANDBY POWER
23. 115 VAC INTERNAL ("LO" SIDE)
24. 115/230 VAC LINE. (115 VAC "LO" SIDE)

	599J
	599H
599723	599G
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWINGS
TOLERANCES
DECIMALS | FRACTIONS | ANGLES
MATERIAL

ENGINEER	2/8/66	
CHECKED		
DRAFTSMAN	Schmidt 1 18 66	

TRACOR, INC. AUSTIN, TEXAS

DIAGRAM, SCHEMATIC
POWER SUPPLY MODULE

SIZE	CODE IDENT NO		
4	19397	599726	X1

SCALE — SHEET 1 OF 1

X. APPENDIX A

OPTIONAL 60 kc/s CONVERTER

I. INTRODUCTION

The optional 60 kc/s Converter extends the capability of the Series 599 VLF Phase-Tracking Receiver into the LF range to allow phase-tracking of WWVB at 60 kc/s. It also provides for detection of carrier amplitude modulation at a modulation frequency of 1 kc/s. Thus, 1 kc/s modulation in the form of second ticks can be processed to obtain a signal either at a front panel PHONE jack (in the case of the Model 599G) or at a loudspeaker (in the case of the Model 599H)(see Note 1). The detected signal is also available at a rear panel connector for visual presentation on an oscilloscope. The STATION selector switch on the front panel permits selection of the 60 kc/s mode of operation (the Synthesizer must be set on 15 kc/s).

A plug-in printed circuit board, Assy 599518, accomplishes conversion of the 60 kc/s input to a coherent 15 kc/s signal for phase-tracking and amplitude detection (the 15 kc/s filter used in the 60 kc/s mode is available at the STATION selector for VLF tracking at 15 kc/s). The coherent 100 kc/s required by the converter and the power required are derived from the Series 599 unit.

The following sections of the appendix give specifications, theory of operation, parts list and schematics for the optional 60 kc/s Converter.

NOTE 1: WWVB has conducted initial time transmissions on the basis of amplitude modulation at a 1 kc/s modulation frequency for a period of 5 milliseconds once each second. However, other modulation methods may be tested from time to time and there is no assurance that the 1 kc/s modulation technique will be utilized in the future.

II. SPECIFICATIONS

Antenna Inputs	In most cases, a single broadband antenna can be used for both 60 kc/s and VLF. Where the environment requires a tuned 60 kc/s antenna or where a whip antenna is used for VLF, an additional antenna input for 60 kc/s can be wired by the manufacturer or in the field.
"TIME" Monitor	A BNC-Type connector is provided on the back panel to permit monitoring of detected and filtered 1 kc/s amplitude modulation. A front panel PHONE jack (in the Model 599G) or loudspeaker (in the Model 599H) provides auditory monitoring of the same signal.
Power Requirement	65 ma at -10 vdc and 65 ma at +10 vdc (from power supply module 599-500).
Gain	Approximately 0 db from 60 kc/s input to 15 kc/s output.
Image Rejection (90 kc/s)	Nominally 30 db.
Bandwidth	4 kc/s nominal.

III. THEORY OF OPERATION

General

A block diagram of the 60 kc/s Converter is shown in Figure 10-1. The antenna input is coupled through a transformer to the 60 kc/s tuned amplifier, which has a bandwidth of about 10 kc/s. Total voltage gain through the transformer and amplifier is about 55 dB. The 90 kc/s notch filter attenuates the image frequency approximately 30 dB. Then the 60 kc/s signal is fed to the mixer.

The coherent 100 kc/s voltage from the receiver is fed to the 100 kc/s to 300 kc/s multiplier. The 300 kc/s voltage is then limited and divided down to 75 kc/s by two bistable multivibrators. Thus, a coherent 75 kc/s voltage is generated for converting the 60 kc/s input signal to a coherent 15 kc/s signal.

The output of the mixer is fed to a 15 kc/s filter with a bandwidth of about 4 kc/s. Conversion loss is about 9 dB. For isolation, the mixer output is buffered by an emitter follower before being fed to a voltage divider, which attenuates the 15 kc/s signal about 46 dB for use in the receiver. Thus, the total gain of the converter to this point is about 0 db.

Additional gain is necessary in order to present time information at a useful level. The output of the emitter follower is amplified by about 34 dB and fed to another 15 kc/s filter with a bandwidth of about 4 kc/s. An isolating amplifier with a gain of about 30 dB follows the filter. The signal is then rectified and fed to a 1 kc/s filter with a 400 cps bandwidth. An additional gain of about 15 dB is provided in the output amplifier on the plug-in printed circuit board. The signal from the plug-in board then goes to the audio circuits of the receiver and the monitor on the back panel of the receiver.

Circuit Description

Input transformer T1 provides a 50 ohm input impedance to the signal entering at pins L and K of P1 and also serves to

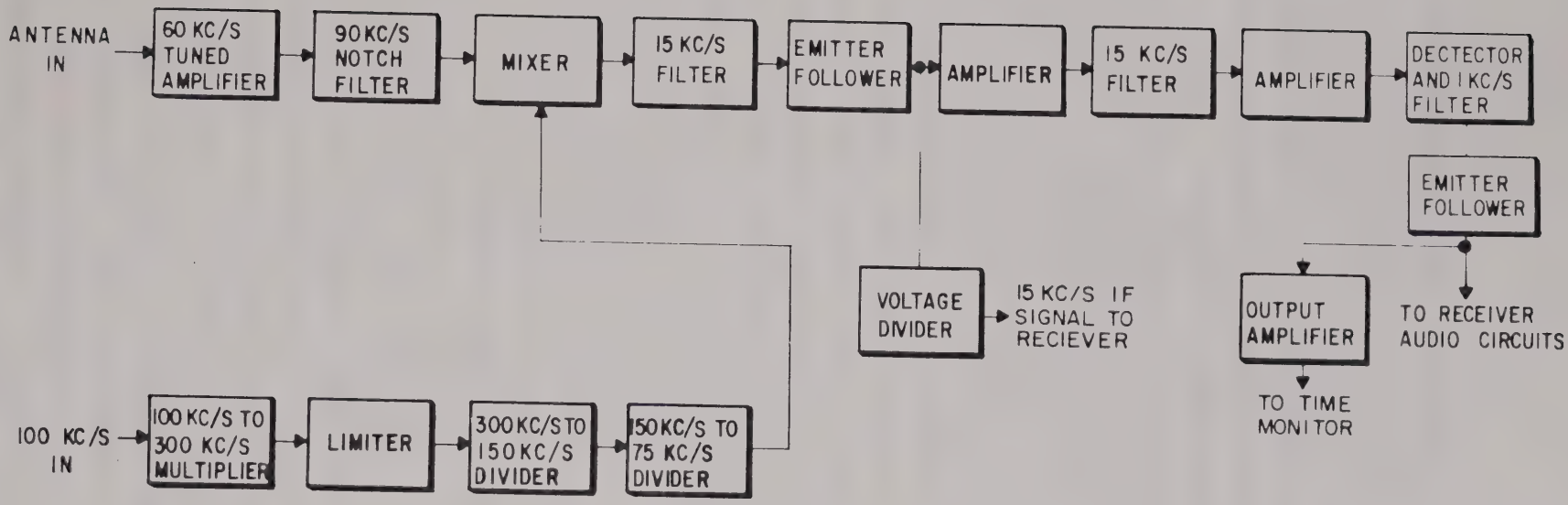


FIGURE 10-1. BLOCK DIAGRAM OF 60 KC CONVERTER

isolate the input circuit from the loop currents.

Q1, L1, and C1 constitute the 60 kc/s tuned amplifier. R3 determines the Q of the circuit. Q2 provides isolation between the tuned amplifier and the 90 kc/s notch filter consisting of L2 and C6. The output of emitter follower Q3 goes to the emitter of the mixer transistor Q4.

The 100 kc/s input voltage at pins H and E is coupled through C26 to the frequency multiplier consisting of Q10, Q11, C27, and L11. Limiting in Q10 and Q11 generates a large third harmonic. The high Q resonant circuit consisting of C27 and L11 tuned to 300 kc/s results in a virtually pure 300 kc/s voltage at the collector of Q11. This voltage is then limited by Q12 and Q13 to produce a 300 kc/s square wave. The square wave is differentiated by C29 and R31; and through steering diodes CR2 and CR3, the resulting pulses are used to trigger the bistable miltivibrator consisting of Q14 and Q15. The voltage at the collector of Q14 is a 150 kc/s square wave. In a like manner, the 150 kc/s square wave is divided down to a 75 kc/s square wave by the bistable multivibrator consisting of Q16 and Q17 and their associated circuit components. The 75 kc/s square wave at the collector of Q16 is then fed to the base of the mixer Q4 through limiting resistor R49.

The output of the mixer is fed to the bandpass filter consisting of L3, C9, L4, C10, L5, and C11 and centered at 15 kc/s. Emitter follower Q5 provides isolation. The output of Q5 is coupled through C12 to the voltage divider consisting of R12 and the receiver input load. The attenuated signal is then fed via pin P of P1 to the Receiver input for phase tracking.

For additional amplification, the signal at the emitter of Q5 is also fed to amplifier Q6. Its output is passed through another bandpass filter consisting of L6, C15, L7, C16, L8, and C17 and centered at 15 kc/s. Isolation and additional amplification is provided by Q7. The output of Q7 is rectified by CR1

and passed through the bandpass filter consisting of L9, C19, C20, C21, and L10 and tuned to 1 kc/s. The detected and filtered 1 kc/s modulation on the carrier is then fed to emitter follower Q8. The output of Q8 is available at pin Z of P1. R53 is provided so that the signal can be reduced to a lower level, compatible with the levels required in the audio circuits of the Series 599 Receiver, for use in certain applications. The emitter follower output is also amplified by Q9 with a gain of approximately 15 dB. The output of Q9 is coupled through C25 to pin S of P1. At this point the modulating signal is suitable for viewing with an oscilloscope or for aural detection at the PHONE jack (in the Model 599G) or loudspeaker (in the Model 599H).

IV. REPLACEABLE PARTS

The following list contains all the replaceable parts in the optional 60 kc/s Converter. When ordering replaceable parts, consult Chapter VIII in this manual.

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
			60KC CONV PCB ASSY	599518
1		82	INSULATOR TSTR	599518
29		3326-0046	BLIND RIVET 1/8X3/8L	599518
35		3571-0753	STRAP RUBBER	599518
49		599264	PRINTED CIRCUIT BOARD	599518
41	C 1	27512-0122	CAP FXD MICA 1200 PF	599518
39	C 2	21485-9101	CAP SOLID TA 1X0 35V	599518
30	C 3	3403-9503	CAP FXD CER X05 50V	599518
30	C 4	3403-9503	CAP FXD CER X05 50V	599518
37	C 5	8917-0121	CAP SOLID TA 120 10V	599518
45	C 6	27512-0681	CAP FXD MICA 680 PF	599518
30	C 7	3403-9503	CAP FXD CER X05 50V	599518
37	C 8	8917-0121	CAP SOLID TA 120 10V	599518
26	C 9	3317-9333	CAP FXD FILM X033 MF	599518
44	C 10	27512-0471	CAP FXD MICA 470 PF	599518
26	C 11	3317-9333	CAP FXD FILM X033 MF	599518
36	C 12	8914-0150	CAP SOLID TA 15 20V	599518
39	C 13	21485-9101	CAP SOLID TA 1X0 35V	599518
18	C 14		NOT USED	599518
26	C 15	3317-9333	CAP FXD FILM X033 MF	599518
44	C 16	27512-0471	CAP FXD MICA 470 PF	599518
26	C 17	3317-9333	CAP FXD FILM X033 MF	599518
39	C 18	21485-9101	CAP SOLID TA 1X0 35V	599518
47	C 19	27513-0682	CAP FXD MICA 6800 PF	599518
46	C 20	27513-0103	CAP FXD MICA 10000 PF	599518
47	C 21	27513-0682	CAP FXD MICA 6800 PF	599518
38	C 22	8917-9471	CAP SOLID TA 4X7 10V	599518
38	C 23	8917-9471	CAP SOLID TA 4X7 10V	599518
0	C 24		NOT USED	599518
38	C 25	8917-9471	CAP SOLID TA 4X7 10V	599518
30	C 26	3403-9503	CAP FXD CER X05 50V	599518
43	C 27	27512-0271	CAP FXD MICA 270 PF	599518
30	C 28	3403-9503	CAP FXD CER X05 50V	599518
44	C 29	27512-0471	CAP FXD MICA 470 PF	599518
44	C 30	27512-0471	CAP FXD MICA 470 PF	599518
44	C 31	27512-0471	CAP FXD MICA 470 PF	599518
40	C 32	27512-0101	CAP FXD MICA 100 PF	599518
44	C 33	27512-0471	CAP FXD MICA 470 PF	599518
44	C 34	27512-0471	CAP FXD MICA 470 PF	599518
30	C 35	3403-9503	CAP FXD CER X05 50V	599518
28	C 36	3324-9334	CAP TUBULAR 3300 PF	599518
42	C 37	27512-0220	CAP FXD MICA 22 PF	599518
37	C 38	8917-0121	CAP SOLID TA 120 10V	599518
37	C 39	8917-0121	CAP SOLID TA 120 10V	599518
55	L 1	599519	INDUCTOR ASSY 4X7 MH	599518
53	L 2	599521-0482	INDUCTOR ASSY 4X8 MH	599518
53	L 3	599521-0482	INDUCTOR ASSY 4X8 MH	599518
52	L 4	599521-0103	INDUCTOR ASSY 10 MH	599518
53	L 5	599521-0482	INDUCTOR ASSY 4X8 MH	599518
33	L 6	3422-0472	INDUCTOR 4X7 MH	599518
32	L 7	3422-0103	INDUCTOR 10 MH	599518
33	L 8	3422-0472	INDUCTOR 4X7 MH	599518
34	L 9	3423-9601	INDUCTOR 6X0 HY	599518
34	L 10	3423-9601	INDUCTOR 6X0 HY	599518
31	L 11	3422-0102	INDUCTOR 1X0 MH	599518
27	P 1	3318-0028	PCB ADAPTER PLUG 22P	599518
25	Q 1	900-2270	TSTR NPN 2N2270	599518
22	Q 2	900-1304	TSTR NPN 2N1304	599518
25	Q 3	900-2270	TSTR NPN 2N2270	599518
24	Q 4	900-1995	TSTR NPN 2N1995	599518
22	Q 5	900-1304	TSTR NPN 2N1304	599518
22	Q 6	900-1304	TSTR NPN 2N1304	599518
22	Q 7	900-1304	TSTR NPN 2N1304	599518
22	Q 8	900-1304	TSTR NPN 2N1304	599518
22	Q 9	900-1304	TSTR NPN 2N1304	599518
22	Q 10	900-1304	TSTR NPN 2N1304	599518
22	Q 11	900-1304	TSTR NPN 2N1304	599518
22	Q 12	900-1304	TSTR NPN 2N1304	599518
22	Q 13	900-1304	TSTR NPN 2N1304	599518
23	Q 14	900-1305	TSTR PNP 2N1305	599518
23	Q 15	900-1305	TSTR PNP 2N1305	599518
23	Q 16	900-1305	TSTR PNP 2N1305	599518
23	Q 17	900-1305	TSTR PNP 2N1305	599518
0	R 1		NOT USED	599518
15	R 2	208-0223	RES FXD COMP 22K	599518
11	R 3	208-0153	RES FXD COMP 15K	599518
8	R 4	208-0103	RES FXD COMP 10K	599518
18	R 5	208-0472	RES FXD COMP 4X7K	599518
14	R 6	208-0222	RES FXD COMP 2X2K	599518
0	R 7		NOT USED	599518
6	R 8	208-0101	RES FXD COMP 100	599518
6	R 9	208-0101	RES FXD COMP 100	599518

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
4	R 10	200-0392	RES FXD COMP 3X9K	599518
14	R 11	208-0222	RES FXD COMP 2X2K	599518
8	R 12	208-0103	RES FXD COMP 10K	599518
0	R 13		NOT USED	599518
14	R 14	208-0222	RES FXD COMP 2X2K	599518
13	R 15	208-0182	RES FXD COMP 1X8K	599518
10	R 16	208-0123	RES FXD COMP 12K	599518
14	R 17	208-0222	RES FXD COMP 2X2K	599518
13	R 18	208-0182	RES FXD COMP 1X8K	599518
17	R 19	208-0470	RES FXD COMP 47	599518
8	R 20	208-0103	RES FXD COMP 10K	599518
8	R 21	208-0103	RES FXD COMP 10K	599518
11	R 22	208-0153	RES FXD COMP 15K	599518
14	R 23	208-0222	RES FXD COMP 2X2K	599518
14	R 24	208-0222	RES FXD COMP 2X2K	599518
13	R 25	208-0182	RES FXD COMP 1X8K	599518
8	R 26	208-0103	RES FXD COMP 10K	599518
8	R 27	208-0103	RES FXD COMP 10K	599518
9	R 28	208-0104	RES FXD COMP 100K	599518
14	R 29	208-0222	RES FXD COMP 2X2K	599518
14	R 30	208-0222	RES FXD COMP 2X2K	599518
7	R 31	208-0102	RES FXD COMP 1K	599518
8	R 32	208-0103	RES FXD COMP 10K	599518
19	R 33	208-0562	RES FXD COMP 5X6K	599518
16	R 34	208-0273	RES FXD COMP 27K	599518
7	R 35	208-0102	RES FXD COMP 1K	599518
6	R 36	208-0101	RES FXD COMP 100	599518
19	R 37	208-0562	RES FXD COMP 5X6K	599518
16	R 38	208-0273	RES FXD COMP 27K	599518
7	R 39	208-0102	RES FXD COMP 1K	599518
7	R 40	208-0102	RES FXD COMP 1K	599518
8	R 41	208-0103	RES FXD COMP 10K	599518
19	R 42	208-0562	RES FXD COMP 5X6K	599518
16	R 43	208-0273	RES FXD COMP 27K	599518
13	R 44	208-0182	RES FXD COMP 1X8K	599518
6	R 45	208-0101	RES FXD COMP 100	599518
19	R 46	208-0562	RES FXD COMP 5X6K	599518
16	R 47	208-0273	RES FXD COMP 27K	599518
13	R 48	208-0182	RES FXD COMP 1X8K	599518
8	R 49	208-0103	RES FXD COMP 10K	599518
8	R 50	208-0103	RES FXD COMP 10K	599518
17	R 51	208-0470	RES FXD COMP 47	599518
12	R 52	208-0181	RES FXD COMP 180	599518
7	R 53	208-0102	RES FXD COMP 1K	599518
20	R 54	208-0682	RES FXD COMP 6X8K	599518
3	R 55	200-0152	RES FXD COMP 1X5K	599518
5	R 56	200-0822	RES FXD COMP 8X2K	599518
2	R 57	200-0100	RES FXD COMP 10	599518
2	R 58	200-0100	RES FXD COMP 10	599518
54	T 1	599522	XFMR ASSY 35T/110T	599518
21	CR 1	801-0096	DIODE 1N96A	599518
21	CR 2	801-0096	DIODE 1N96A	599518
21	CR 3	801-0096	DIODE 1N96A	599518
21	CR 4	801-0096	DIODE 1N96A	599518
21	CR 5	801-0096	DIODE 1N96A	599518
			60KC OPTION ASSY	599793
1		173-0016	SCR BH 2 56X1/4	599793
3		175-0040	SCREW 4 40X5/8 BH	599793
4		218-0048	SCREW 4 40X3/4 FH	599793
5		620-0123	LOCKWASHER NO 4	599793
6		649-0074	NUT 4 40	599793
7		736-1003	NUT 6 32X11/32 DIA	599793
8		3888-0001	FISHPAPER 3 X 9X25	599793
12		599253-0110	SPACER	599793
14		599373-0150	SCR 15X0 STA FREQ	599793
15		599373-0600	SCR 60X0 STA FREQ	599793
16		599409	PLATE	599793
20		599564	SHIELD PCB	599793
19	A 8	599518	ASSY PCB 60 KC CONV	599793
9	FL 4	599175-0150	RF FILTER 15X0KC FREQ	599793

TRACOR STOCK NUMBER	DESCRIPTION	MANUFACTURER CODE NUMBER	MANUFACTURER PART NUMBER	TOTAL QUANTITY
82	MOUNT TSTR	17069	88000	17.
173-0016	SCR BND HD 256 X 1	73734	4002	4.
175-0040	SCR BND HD 4 40X5/8L	73734	4027	3.
200-0100	RES FXD COMP 10 OHM	01121	RC07GF100K (MIL-R-11/8)	2.
200-0152	RES FXD COMP 1X5 K	01121	RC07GF152K (MIL-R-11/8)	1.
200-0392	RES FXD COMP 3X9K	01121	RC07GF392K (MIL-R-11/8D)	1.
200-0822	RES FXD COMP 8X2K	01121	RC07GF822K (MIL-R-11/8D)	1.
208-0101	RES FXD COMP 100 OHM	01121	RC20GF101K (MIL-R-11/3)	4.
208-0102	RES FXD COMP 1 K	01121	RC20GF102K (MIL-R-11/3)	5.
208-0103	RES FXD COMP 10K	01121	RC20GF103K (MIL-R-11/3)	10.
208-0104	RES FXD COMP 100K	01121	RC20GF104K (MIL-R-11/3)	1.
208-0123	RES FXD COMP 12K	01121	RC20GF123K (MIL-R-11/3)	1.
208-0153	RES FXD COMP 15K	01121	RC20GF153K (MIL-R-11/3)	2.
208-0181	RES FXD COMP 180 OHM	01121	RC20GF181K (MIL-R-11/3)	1.
208-0182	RES FXD COMP 1X8K	01121	RC20GF182K (MIL-R-11/3)	5.
208-0222	RES FXD COMP 2X2K	01121	RC20GF222K (MIL-R-11/3)	8.
208-0223	RES FXD COMP 22K	01121	RC20GF223K (MIL-R-11/3)	1.
208-0273	RES FXD COMP 27K	01121	RC20GF273K (MIL-R-11/3)	4.
208-0470	RES FXD COMP 47 OHM	01121	RC20GF470K (MIL-R-11/3)	2.
208-0472	RES FXD COMP 4X7K	01121	RC20GF472K (MIL-R-11/3)	1.
208-0562	RES FXD COMP 5X6K	01121	RC20GF562K (MIL-R-11/3)	4.
208-0682	RES FXD COMP 6X8K	01121	RC20GF682K (MIL-R-11/3)	1.
218-0048	SCR FLAT HD 4 40X3/4	73734	2137	2.
620-0123	WASHER LOCK INT NO 4	73734	1302	5.
649-0074	NUT HEX 4 40X1/4AF	73734	8003	2.
736-1003	NUT THUMB 6 32X11/32	73734	8075NP	2.
801-0096	DIODE 1N96A	73293	1N96A	5.
900-1304	TSTR 2N1304	01295	2N1304	10.
900-1305	TSTR 2N1305	01295	2N1305	4.
900-1995	TSTR 2N1995	01295	2N1995	1.
900-2270	TSTR 2N2270	01295	2N2270	2.
3317-9333	CAP FXD MYLAR X033MFD	04099	MMW33325	4.
3318-0028	CONN PLUG ELEC 22 PIN	02660	133-022-03	1.
3324-9334	CAP FXD MYL X0033MFD	56289	192P33292	1.
3326-0046	RIVET POP 1/8X481	04707	AD46BS	2.
3403-9503	CAP FXD CER X05 MFD	80183	TG S50	6.
3422-0102	INDUCTOR 1000MH	99800	2500-28	1.
3422-0103	INDUCTOR 10000MH	99800	2500-76	1.
3422-0472	INDUCTOR 4700MH	99800	2500-60	2.
3423-9601	INDUCTOR 6 MH	80223	ML7	2.
3571-0753	STRAP TIE DOWN 3 INCH	98159	2829-75-3	2.
3888-0001	PAPER INSULATING	72653	560	1.
8914-0150	CAP FXD ELECT 15 MFD	05397	CS13BE156K (MIL-L-26655/2D)	1.
8917-0121	CAP FXD TA 120 10V	01295	CS13BC127K (MIL-C-26655/2D)	4.
8917-9471	CAP FXD TA 4X7MFD	05397	CS13BC475K (MIL-C-26655/2D)	3.
21485-9101	CAP FXD TA 1X0 MFD	05397	CS13BF105K (MIL-C-26655/2D)	3.
27512-0101	CAP FXD MICA 100 PFD	00853	CM05F101G03 (MIL-C-5/18)	1.
27512-0122	CAP FXD MICA 1200 PFD	00853	CM06F122G03 (MIL-C-5/18)	1.
27512-0220	CAP FXD MICA 22 PFD	00853	CM05E220J03 (MIL-C-5/18)	1.
27512-0271	CAP FXD MICA 270 PFD	00853	CM05F271G03 (MIL-C-5/18)	1.
27512-0471	CAP FXD MICA 470 PFD	00853	CM06F471G03 (MIL-C-5/18)	7.
27512-0681	CAP FXD MICA 680 PFD	00853	CM06F681G03 (MIL-C-5/18)	1.
27513-0103	CAP FXD MICA 10000 PF	84171	DM-20-103G	1.
27513-0682	CAP FXD MICA 6800 PFD	72982	DM-19-682G	2.
599175-0150	FILTER	19397	599175-0150	1.
599253-0110	SPACER	19397	599253-0110	3.
599264	BOARD PRINTED CKT	19397	599264	1.
599373-0150	SCR 15X0 STA FREQ	19397	599373-0150	1.
599373-0600	SCR 60X0 STA FREQ	19397	599373-0600	1.
599409	PLATE ESCUTCHEON	19397	599409	1.
599518	PCB 60KC CONV ASSY	19397	599518	1.
599519	INDUCTOR ASSY 4X7 MH	19397	599519	1.
599521-0103	ASSY IND 60KC CONV	19397	599521-0103	1.
599521-0482	ASSY IND 60KC CONV	19397	599521-0482	3.
599522	TRANSFORMER ASSY	19397	599522	1.
599564	SCHIELD PCB	19397	599564	1.

V. SCHEMATIC

Dwg. No.	Title
599263	Schematic Diagram, 60 kc/s Converter, Assy 599518.

Dwg. No.	Title
6788	Omega Cable Assembly

APPENDIX B

OMEGA OPTION

I. INTRODUCTION

The Omega Option permits the Model 599 Series VLF phase-tracking receiver and the Model 533 Omega Gating Unit to operate together for tracking time-shared omega transmissions. The Option Kit contains the following items:

A. An AGC clamping board
B. An omega cable
C. Installation instructions
D. Required hardware

The AGC Clamping Board (PCB Assembly 599790) is used to provide proper AGC action when tracking short duty-cycle omega stations and is installed in the AGC Phase Module.

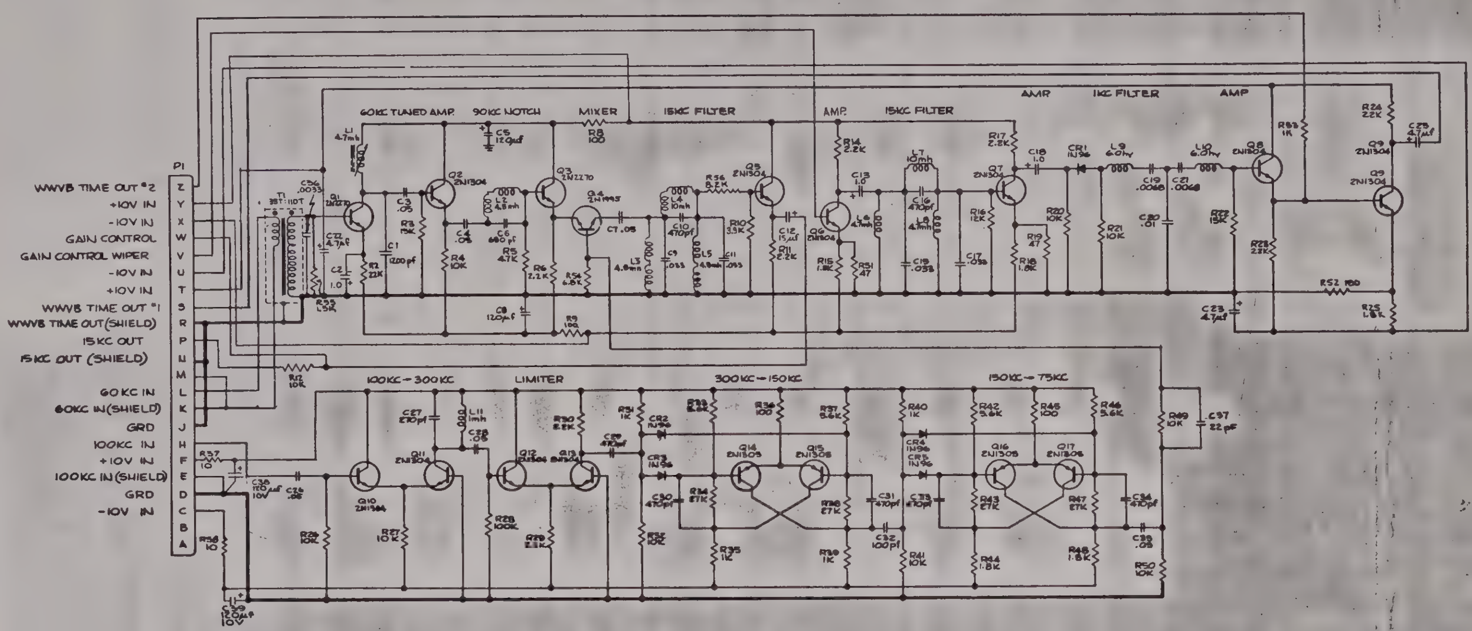
The Omega Cable (TRACOR No. 6788) provides for all interconnections between the Omega Gating Unit and the VLF Receiver except for the Omega Gating Unit's 100 CPS INPUT. This has to be taken from the receiver's coherent 100 CPS OUTPUT with a separate cable.

II. SPECIFICATIONS

The receiver's specifications with the Omega Modification are the same as the receiver alone but for the following:

A. The coherent 100 CPS OUTPUT is 8 volts nominal instead of 0.5 volts nominal.
B. The signal-to-noise ratio is slightly degraded (see following page for explanation).

NOTES:
1. ALL CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED



F	ECO 508 CHG TITLE		
E	REVISED PER ECO NO. 197		
D			
C			
B			
A			
SYM	DATE	REVISIONS	NAME

19397

DO NOT SCALE DWG

60KC CONVERTER
ASSY 599518

TRACOR, INC
AUSTIN, TEXAS

4599263 F

MATERIAL

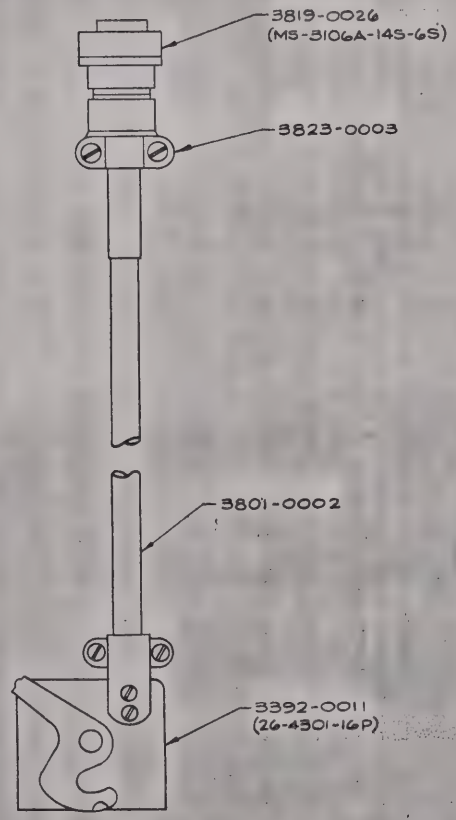
FINISH

TOLERANCES UNLESS OTHERWISE SPECIFIED

CLASS 2 FIT

RAE

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	X1	RELEASED	3/20/66	JGS



FROM	TO	LENGTH (IN)	WIRE SIZE	COLOR CODE	REMARKS
PIN D	PIN 16	6FT		SHIELD	SEE NOTE 1
PIN B	PIN 10	6FT	20		SEE NOTE 1
PIN F	PIN 14	6FT	20		SEE NOTE 1
PIN C	PIN 7	6FT	20		SEE NOTE 1
PIN A	PIN 8	6FT	20		SEE NOTE 1
PIN E		6FT	20		NO CONNECTION
PIN 7	PIN 2	1.5IN	20	RED	SEE NOTE 2

NOTES:
1. ALL ALPHABETICALLY DESIGNATED PINS WILL BE LOCATED ON MS-3106A-14S-6S. NUMERICALLY DESIGNATED PINS WILL BE LOCATED ON AMPH CONNECTOR 26-4301-16P
2. THIS WIRE IS A JUMPER INSIDE 26-4301-16P AND IS NOT A PART OF CABLE, 3801-0002.

	599H
599792	599G
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWINGS

TOLERANCES UNLESS OTHERWISE SPECIFIED

DECIMALS	FRACTIONS	ANGLES

MATERIAL:

ENGINEER	John Seelig	4-20-66
CHECKED	[illegible]	4-2
DRAFTSMAN	Schmidt	4 18 66

TRACOR, INC. AUSTIN, TEXAS

OMEGA CABLE ASSY

SIZE	CODE IDENT NO.		
3	19397	6788	X1
SCALE 1/1			SHEET 1 OF 1

TRACOR STOCK NO. 3309

III. THEORY OF OPERATION

A block diagram of the AGC clamping function is shown in Figure 10-2. The AGC clamping circuits convert the dc amplifier's open-loop gain to unity by positive signal feedback and dc offset adjustment. When the carrier is off, the carrier relay, K301, (Schematic Diagram 599393) transfers the amplifier's input to the clamping circuit's output, thus maintaining the same AGC level. R802, R803 and R804 (Schematic Diagram 599798) adjust the bias while R801, R805 and R808 provide proper signal level.

During Omega operation, K301 is operated by the Omega Gating Unit through R806 (599798).

The AGC synchronous detector's time constant (599393) is decreased with this option by replacing C307 (599393) with C801 and C802 (599798). By decreasing the time constant to allow for the short omega transmission "on" time the signal-to-noise ratio of the receiver is slightly degraded.

The signal level at the receiver's coherent 100 CPS OUTPUT is increased with this option to ensure compatibility with the Omega Gating Unit.

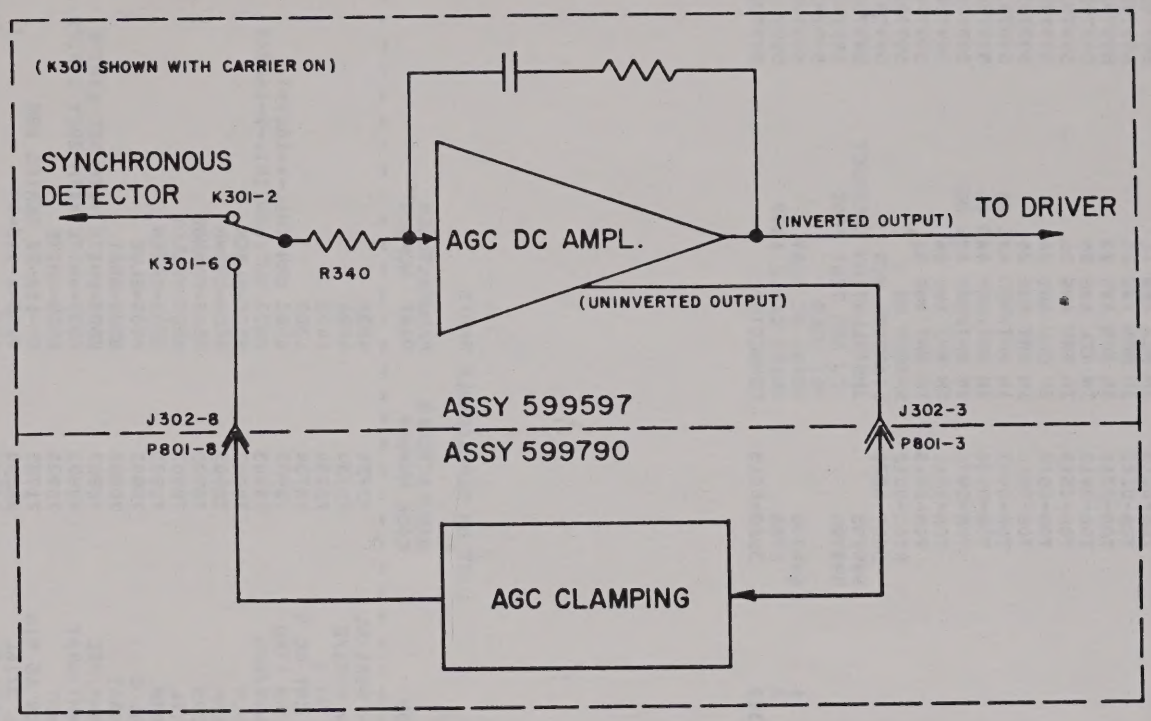


FIGURE 10-2. BLOCK DIAGRAM OF AGC CLAMPING FUNCTION

ITEM/REFERENCE DESIGNATION INDEX

DATE 01/26/67

ITEM NUMBER	REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	STOCK NUMBER USED ON
			OMEGA OPTION KIT ASSY	599792
1		175-0016	SCR BH 4 40 1/4	599792
2		175-0032	SCR BH 4 40 1/2	599792
2		175-0032	SCR 4 40 1/2	599792
3		617-0256	WASH FL NO 4	599792
3		617-0256	WASH FLT NO 4	599792
4		620-0123	WASH INT LOCK NO 4	599792
4		620-0123	WASH INT LOCK NO 4	599792
5		705-0510	IN GRN AWG 22	599792
6		705-0905	IN WHT/GRN AWG 22	599792
7		706-0010	IN BLK AWG IL	599792
8		706-0110	IN BRN AWG 26	599792
9		706-0310	IN ORN AWG 26	599792
10		706-0410	IN YEL AWG 26	599792
11		706-0510	IN GRN AWG 26	599792
12		706-0610	IN BLU AWG 26	599792
13		706-0810	IN GRY AWG 26	599792
14		706-0902	IN WHT/RED AWG 26	599792
15		706-0908	IN WHT/GRY AWG 26	599792
15		706-0908	IN WHT/GRY AWG 26	599792
16		706-0910	IN WHT AWG 26	599792
16		706-0910	IN WHT AWG 26	599792
18		4720-0012	SPACER NO 4	599792
19		5057-0032	STANDOFF HEX	599792
24		599795	INSTALLATION INSTRUCT	599792
25		599796	ADJ AND TEST PROC	599792
26			NOT USED	599792
23	A 1	599790	BOARD PC ASSY	599792
22	A 2	6788	OMEGA CABLE ASSY	599792
17	J 302	3628-0015	CONNECTOR	599792

LIST OF REPLACEABLE PARTS

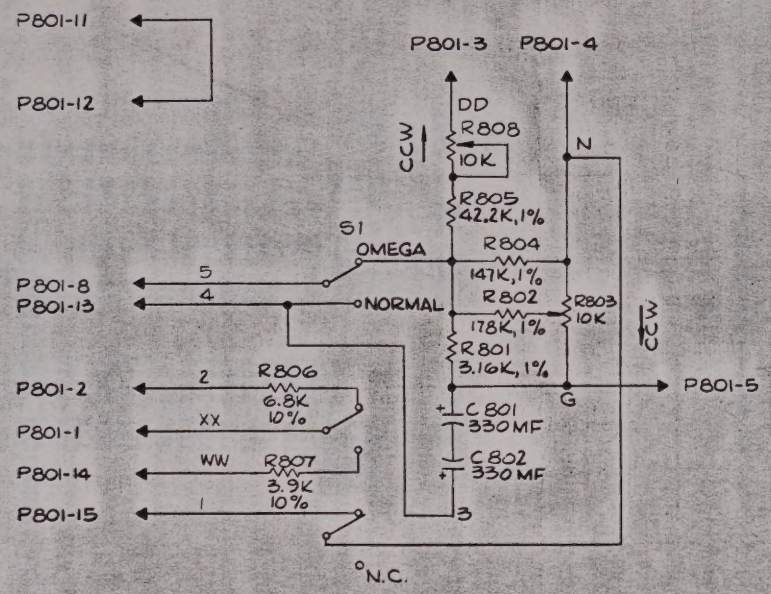
DATE 01/26/67

TRACOR STOCK NUMBER	DESCRIPTION	MANUFACTURER CODE NUMBER	MANUFACTURER PART NUMBER	TOTAL QUANTITY
175-0016	SCR BND HD 4 40X1/4L	73734	4022	2.
175-0032	SCR BND HD 4 40X1/2	73734	4026	3.
617-0256	WASHER FLAT NO 4	73734	1402	3.
620-0123	WASHER LOCK INT NO 4	73734	1302	5.
705-0510	WIRE 22AWG GRN STRD	70903	8503 GRN (MIL-W-16878)	18.
705-0905	WIRE 22AWG WHT/GRN	70903	8503 WHT/GRN (MIL-W-16878)	24.
706-0010	WIRE 26AWG BLK	70903	8505-BLACK	18.
706-0110	WIRE 26AWG BRN	70903	8505-BROWN	18.
706-0310	WIRE 26AWG ORN	70903	8505-ORANGE	18.
706-0410	WIRE 26AWG YEL	70903	8505-YELLOW	18.
706-0510	WIRE 26AWG GRN	70903	8505-GREEN	18.
706-0610	WIRE 26AWG BLUE	70903	8505-BLUE	18.
706-0810	WIRE 26AWG GRAY	70903	8505-GRAY	18.
706-0902	WIRE 26AWG WHT/RED	70903	8505-WHITE WITH RED STRIPE	18.
706-0908	WIRE 26AWG WHT/GRAY	70903	8505-WHITE WITH GREY STRIPE	36.
706-0910	WIRE 26AWG WHT	70903	8505-WHITE	36.
3628-0015	CONNECTOR PCB 15 PIN	71785	50-15A-20 SERIES 250	1.
4720-0012	SPACER RD AL 3/16L	06540	9208-A-115-1B	1.
5057-0032	STANDOFF 4 40X1/2	83330	2332	2.
6788	OMEGA CABLE ASSY	19397	6738	1.
599790	BOARD PC AGC ASSY	19397	599790	1.
599795	INSTALLATION INSTRUCT	19397	599795	1.
599796	ADJ AND TEST PROC	19397	599796	1.

IV. SCHEMATIC DIAGRAM

Dwg. No.	Title
599798	Diagram, Schematic, AGC Clamping Board

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	X1	RELEASED	7/20/66	
	A	CHG TO INCLUDE 599J; ECO 1778	1-11-67	



NOTES:
1. 10% RESISTORS ARE $\frac{1}{4}$ W.
2. 1% RESISTORS ARE $\frac{1}{8}$ W.
3. P801 PLUGS INTO J 302
(REFERENCE DIAGRAM SCHEMATIC 599393 FOR 599 G OR H
REFERENCE DIAGRAM SCHEMATIC 599771 FOR 599 J)

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING		TRACOR, INC.	AUSTIN, TEXAS
		TOLERANCES UNLESS OTHERWISE SPECIFIED	ENGINEER 4-27-66	DIAGRAM, SCHEMATIC AGC CLAMPING BOARD	
		DEC — FRACT — ANG —	CHECKED 6-27-66		
	599H		DRAFTSMAN 4-27-66		
599790	599G	MATERIAL:		SIZE 2 CODE IDENT NO. 19397	599798 A
NEXT ASSY	USED ON			SCALE —	SHEET 1 OF 1
APPLICATION					

TRACOR STOCK NO. 3308-0001